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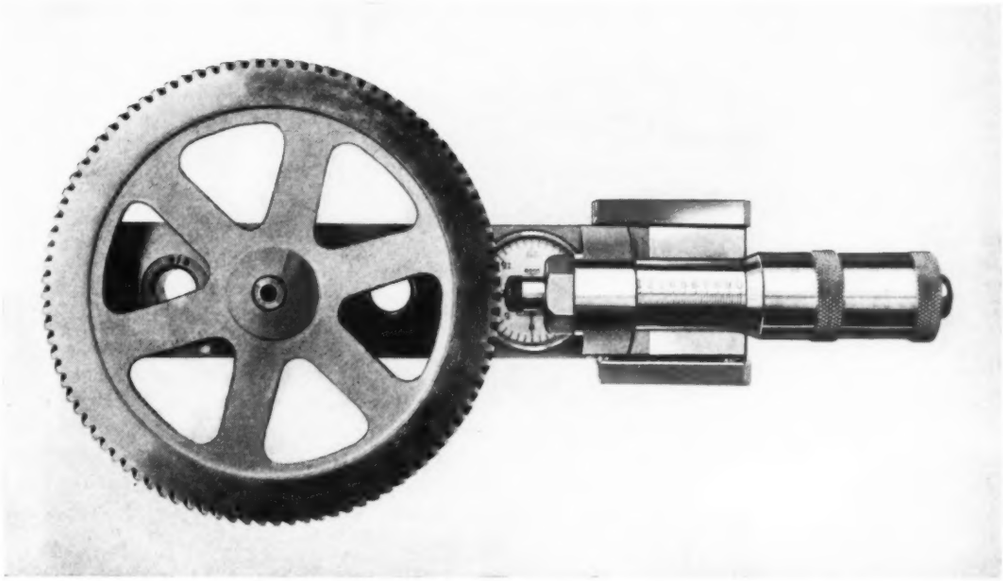
Checking Gear Size by Measurement Over Pins



Tables Simplifying Application of This Precise and Generally Available Method to External and Internal Spur and Helical Gears

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THE pin or roll method of checking gear sizes is accurate, easily applied, and especially useful in shops with limited inspection equipment. Two cylindrical pins of predetermined diameter are placed in diametrically opposite tooth spaces (see diagram on page 356). If the gear has an odd number of teeth, the pins are located as nearly opposite as possible, as shown by the diagram at the right. The over-all measurement *M* is checked by using a micrometer for small gears or any other sufficiently accurate method of measurement for larger gears.

The pin method is similar in principle to the three-wire method for measuring screw threads. In the case of a gear, it is essential to determine the value of measurement *M* when the pitch diameter is correct. The calculation of dimension *M* requires considerable time and the use of cumbersome formulas, but it can be determined easily and quickly by means of the calculated values in the accompanying tables. These values are used in conjunction with simple rules or formulas, as shown by examples applying both to spur and helical gears. The tables and formulas are applicable either to American standard involute or composite tooth forms, to both full-depth and stub teeth, and to pressure angles of 14 1/2 and 20 degrees.

Table 1. Data for Checking Spur and Helical Gear Sizes by Measurement Over Pins or Balls

No. of Teeth	Value of Y		Factor F	No. of Teeth	Value of Y		Factor F	No. of Teeth	Value of Y		Factor F	No. of Teeth	Value of Y		Factor F
	14½° Pressure Angle	20° Pressure Angle			14½° Pressure Angle	20° Pressure Angle			14½° Pressure Angle	20° Pressure Angle			14½° Pressure Angle	20° Pressure Factor	
10	0.4912	0.5114		74	0.6020	0.5790		138	0.6157	0.5862		172	0.6192	0.5878	
11	0.4976	0.5181	1.0103	75	0.6025	0.5793	1.0002	139	0.6159	0.5862	1.00005	173	0.6192	0.5878	1.00005
12	0.5040	0.5248		76	0.6030	0.5795		140	0.6160	0.5863		174	0.6193	0.5878	
13	0.5101	0.5274	1.0073	77	0.6035	0.5798	1.0002	141	0.6162	0.5863	1.00005	175	0.6193	0.5879	1.00005
14	0.5163	0.5310		78	0.6040	0.5800		142	0.6163	0.5864		176	0.6194	0.5879	
15	0.5211	0.5340	1.0055	79	0.6045	0.5803	1.0002	143	0.6164	0.5864	1.00005	177	0.6194	0.5879	1.00005
16	0.5260	0.5370		80	0.6050	0.5805		144	0.6165	0.5865		178	0.6195	0.5879	
17	0.5300	0.5395	1.0043	81	0.6053	0.5808	1.0002	145	0.6166	0.5865	1.00005	179	0.6195	0.5880	1.00005
18	0.5340	0.5420		82	0.6055	0.5810		146	0.6167	0.5866		180	0.6195	0.5880	
19	0.5373	0.5440	1.0034	83	0.6058	0.5813	1.0002	147	0.6168	0.5866	1.00005	181	0.6195	0.5880	1.00005
20	0.5406	0.5460		84	0.6060	0.5815		148	0.6169	0.5867		182	0.6196	0.5880	
21	0.5433	0.5475	1.0028	85	0.6063	0.5818	1.0002	149	0.6170	0.5867	1.00005	183	0.6196	0.5881	1.00005
22	0.5460	0.5490		86	0.6065	0.5820		150	0.6171	0.5868		184	0.6196	0.5881	
23	0.5485	0.5505	1.0023	87	0.6068	0.5822	1.0002	151	0.6172	0.5868	1.00005	185	0.6197	0.5881	1.00005
24	0.5510	0.5520		88	0.6070	0.5824		152	0.6173	0.5869		186	0.6197	0.5881	
25	0.5537	0.5535	1.0020	89	0.6073	0.5826	1.0002	153	0.6174	0.5869	1.00005	187	0.6197	0.5882	1.00005
26	0.5565	0.5550		90	0.6075	0.5827		154	0.6175	0.5870		188	0.6197	0.5882	
27	0.5587	0.5560	1.0017	91	0.6078	0.5829	1.0002	155	0.6176	0.5870	1.00005	189	0.6198	0.5882	1.00005
28	0.5610	0.5570		92	0.6080	0.5830		156	0.6177	0.5871		190	0.6198	0.5882	
29	0.5630	0.5580	1.0015	93	0.6083	0.5832	1.0001	157	0.6178	0.5871	1.00005	191	0.6198	0.5883	1.00005
30	0.5650	0.5590		94	0.6085	0.5833		158	0.6179	0.5872		192	0.6198	0.5883	
31	0.5670	0.5600	1.0013	95	0.6088	0.5835	1.0001	159	0.6180	0.5872	1.00005	193	0.6199	0.5883	1.00005
32	0.5690	0.5610		96	0.6090	0.5836		160	0.6181	0.5873		194	0.6199	0.5883	
33	0.5705	0.5620	1.0011	97	0.6093	0.5837	1.0001	161	0.6182	0.5873	1.00005	195	0.6199	0.5884	1.00005
34	0.5720	0.5630		98	0.6095	0.5838		162	0.6183	0.5874		196	0.6199	0.5884	
35	0.5730	0.5640	1.0010	99	0.6098	0.5839	1.0001	163	0.6184	0.5874	1.00005	197	0.6199	0.5884	1.00005
36	0.5740	0.5650		100	0.6100	0.5840		164	0.6185	0.5875		198	0.6200	0.5884	
37	0.5750	0.5655	1.0009	101	0.6102	0.5841	1.0001	165	0.6186	0.5875	1.00005	199	0.6200	0.5885	1.00005
38	0.5760	0.5660		102	0.6103	0.5842		166	0.6187	0.5876		200	0.6200	0.5885	
39	0.5770	0.5665	1.0008	103	0.6105	0.5843	1.0001	167	0.6188	0.5876	1.00005	201	0.6200	0.5885	1.00005
40	0.5780	0.5670		104	0.6106	0.5844		168	0.6189	0.5877		202	0.6200	0.5885	
41	0.5790	0.5675	1.0007	105	0.6108	0.5845	1.0001	169	0.6190	0.5877	1.00005	203	0.6200	0.5885	1.00005
42	0.5800	0.5680		106	0.6109	0.5846		170	0.6191	0.5877		204	0.6201	0.5885	
43	0.5810	0.5685	1.0006	107	0.6111	0.5846	1.0001	171	0.6191	0.5878	1.00005	205	0.6201	0.5885	1.00005
44	0.5820	0.5690		108	0.6112	0.5847									
45	0.5830	0.5695	1.0006	109	0.6114	0.5847	1.0001								
46	0.5840	0.5700		110	0.6115	0.5848									
47	0.5850	0.5705	1.0005	111	0.6117	0.5848	1.0001								
48	0.5860	0.5710		112	0.6118	0.5849									
49	0.5870	0.5714	1.0005	113	0.6120	0.5849	1.0001								
50	0.5880	0.5717		114	0.6121	0.5850									
51	0.5890	0.5721	1.0005	115	0.6123	0.5850	1.0001								
52	0.5900	0.5724		116	0.6124	0.5851									
53	0.5910	0.5728	1.0004	117	0.6126	0.5851	1.0001								
54	0.5920	0.5731		118	0.6127	0.5852									
55	0.5925	0.5735	1.0004	119	0.6129	0.5852	1.0001								
56	0.5930	0.5738		120	0.6130	0.5853									
57	0.5935	0.5741	1.0004	121	0.6132	0.5853	1.0001								
58	0.5940	0.5744		122	0.6133	0.5854									
59	0.5945	0.5747	1.0004	123	0.6135	0.5854	1.0001								
60	0.5950	0.5750		124	0.6136	0.5855									
61	0.5955	0.5753	1.0003	125	0.6138	0.5855	1.0001								
62	0.5960	0.5756		126	0.6139	0.5856									
63	0.5965	0.5759	1.0003	127	0.6141	0.5856	1.0001								
64	0.5970	0.5762		128	0.6142	0.5857									
65	0.5975	0.5765	1.0003	129	0.6144	0.5857	1.0001								
66	0.5980	0.5768		130	0.6145	0.5858									
67	0.5985	0.5771	1.0003	131	0.6145	0.5858	1.0001								
68	0.5990	0.5774		132	0.6148	0.5859									
69	0.5995	0.5777	1.0003	133	0.6150	0.5859	1.0001								
70	0.6000	0.5780		134	0.6151	0.5860									
71	0.6005	0.5783	1.0002	135	0.6153	0.5860	1.0001								
72	0.6010	0.5785		136	0.6154	0.5861									
73	0.6015	0.5788	1.0002	137	0.6156	0.5861	1.00005								

In the formulas below, M = measurement over pins or balls, inches; D = pitch diameter, inches; P = diametral pitch; P_n = normal diametral pitch; Y = a factor for spur gears (Table 1); Y_h = a factor for helical gears = Y for that number of teeth nearest actual number $N \times C$ (Table 3); and A = diameter of ball or roll (Table 2).

For External Spur Gears

$$M \text{ (No. of teeth, even)} = D + \frac{Y}{P} + A \qquad (1)$$

$$M \text{ (No. of teeth, odd)} = \frac{D + \frac{Y}{P}}{F} + A \qquad (2)$$

For Internal Spur Gears

$$M \text{ (No. of teeth, even)} = D - \left(\frac{Y}{P} + A\right) \qquad (3)$$

$$M \text{ (No. of teeth, odd)} = \frac{D - \frac{Y}{P}}{F} - A \qquad (4)$$

For External Helical Gears

$$M \text{ (No. of teeth, even)} = D + \frac{Y_h}{P_n} + A \qquad (5)$$

$$M \text{ (No. of teeth, odd)} = \frac{D + \frac{Y_h}{P_n}}{F} + A \qquad (6)$$

For Internal Helical Gears

$$M \text{ (No. of teeth, even)} = D - \left(\frac{Y_h}{P_n} + A\right) \qquad (7)$$

$$M \text{ (No. of teeth, odd)} = \frac{D - \frac{Y_h}{P_n}}{F} - A \qquad (8)$$

Gears without allowance for backlash between the teeth will first be selected as examples to illustrate the application of this simple method of determining the over-all pin measurement. Later the slight modification of this measurement to allow for a given amount of backlash will be explained.

Checking Spur Gear Having an Even Number of Teeth

Rule 1—The following rule applies to external spur gears having an even number of teeth and no allowance for backlash. In Table 1, opposite the required number of teeth and under the pressure angle, find the value Y. Divide this value Y by the diametral pitch of the gear to be measured; add the quotient to the pitch diameter plus the diameter of the pins or rolls used. The result equals measurement M over the pins or rolls. The pin diameters for different pitches are given in Table 2.

This rule expressed as a formula will be found at the end of Table 1 [see Formula (1)].

Example 1—A spur gear has 40 teeth of 4 diametral pitch, making the pitch diameter equal 10 inches. The pressure angle is 14 1/2 degrees. Determine measurement M, assuming that the gear is to be cut without allowance for backlash.

Referring to Table 1, the value of Y opposite 40 teeth, in the column for a pressure angle of 14 1/2 degrees, is 0.5780.

The pin diameter A for a diametral pitch of 4 (see Table 2) is 0.42. Then

$$M = 10 + \frac{0.5780}{4} + 0.42 = 10.5645 \text{ inches}$$

Table 2. Pin Diameter Required for Given Pitch

Diametral or Normal Diam. Pitch	Equivalent Circular Pitch	Pin Diameter A	Diametral or Normal Diam. Pitch	Equivalent Circular Pitch	Pin Diameter A	Diametral or Normal Diam. Pitch	Equivalent Circular Pitch	Pin Diameter A
1/2	6.2832	3.3600	9	0.3491	0.1867	32	0.0982	0.0525
3/4	4.1888	2.2400	10	0.3142	0.1680	34	0.0924	0.0494
1	3.1416	1.6800	11	0.2856	0.1527	36	0.0873	0.0467
1 1/4	2.5133	1.3440	12	0.2618	0.1400	38	0.0827	0.0442
1 1/2	2.0944	1.1200	13	0.2417	0.1292	40	0.0785	0.0420
1 3/4	1.7952	0.9060	14	0.2244	0.1200	42	0.0748	0.0400
2	1.5708	0.8400	15	0.2094	0.1120	44	0.0714	0.0382
2 1/4	1.3963	0.7666	16	0.1963	0.1050	46	0.0683	0.0365
2 1/2	1.2566	0.6720	17	0.1848	0.0988	48	0.0654	0.0350
2 3/4	1.1424	0.6109	18	0.1745	0.0934	50	0.0628	0.0336
3	1.0472	0.5600	19	0.1653	0.0885	54	0.0582	0.0311
3 1/2	0.8976	0.4800	20	0.1571	0.0840	56	0.0561	0.0300
4	0.7854	0.4200	22	0.1428	0.0764	60	0.0524	0.0280
5	0.6283	0.3360	24	0.1309	0.0700	64	0.0492	0.0263
6	0.5236	0.2800	26	0.1208	0.0646	80	0.0393	0.0210
7	0.4488	0.2400	28	0.1122	0.0600	..	.....	.....
8	0.3927	0.2100	30	0.1047	0.0560	..	.....	.....

Pin diameter = 1.68 ÷ diametral pitch for spur gears and 1.68 ÷ normal diametral pitch for helical gears.

Table 3. Factors C for Checking Helical Gears by Pin Method

Helix Angle	Factor C	Helix Angle	Factor C	Helix Angle	Factor C	Helix Angle	Factor C
5°	1.01	25°	1.35	38°	2.05	51°	4.01
10°	1.05	26°	1.38	39°	2.13	52°	4.29
12°	1.07	27°	1.41	40°	2.23	53°	4.59
14°	1.10	28°	1.45	41°	2.33	54°	4.93
16°	1.13	29°	1.50	42°	2.44	55°	5.30
17°	1.14	30°	1.54	43°	2.56	56°	5.72
18°	1.16	31°	1.58	44°	2.69	57°	6.19
19°	1.18	32°	1.64	45°	2.83	58°	6.72
20°	1.20	33°	1.70	46°	2.99	59°	7.32
21°	1.23	34°	1.76	47°	3.15	60°	8.00
22°	1.25	35°	1.82	48°	3.34	...	....
23°	1.28	36°	1.89	49°	3.55	...	....
24°	1.31	37°	1.96	50°	3.77	...	....

Checking Spur Gear Having an Odd Number of Teeth

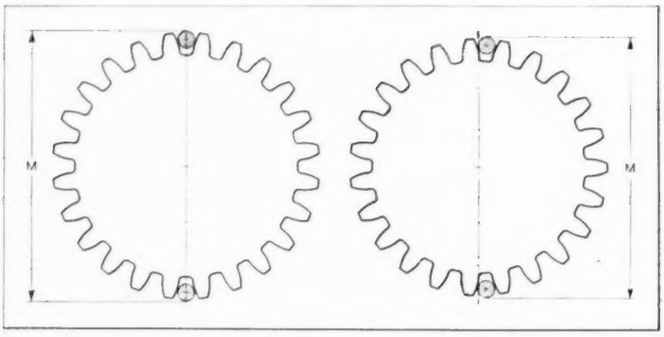
Rule 2—This rule applies to external spur gears having an odd number of teeth and no allowance for backlash. Find, in Table 1, the value of Y opposite the number of teeth and under the pressure angle. Divide this value Y by the diametral pitch and add the quotient to the pitch diameter; then divide this sum by value F (Table 1) opposite the number of teeth and add this final quotient to the pin diameter in order to obtain the measurement M.

This rule expressed as a formula will be found at the end of Table 1 [see Formula (2)].

Table 4. Backlash and Allowance for Obtaining it when Checking Gears by Pin Method

Amount of Backlash, Inch	Allowance B		Amount of Backlash, Inch	Allowance B		Amount of Backlash, Inch	Allowance B	
	14 ½° Pressure Angle	20° Pressure Angle		14 ½° Pressure Angle	20° Pressure Angle		14 ½° Pressure Angle	20° Pressure Angle
0.0005	0.002	0.0015	0.009	0.036	0.0263	0.0175	0.070	0.0512
0.001	0.004	0.0029	0.0095	0.038	0.0277	0.018	0.072	0.0526
0.0015	0.006	0.0044	0.010	0.040	0.0292	0.0185	0.074	0.0540
0.002	0.008	0.0059	0.0105	0.042	0.0307	0.019	0.076	0.0555
0.0025	0.010	0.0073	0.011	0.044	0.0321	0.0195	0.078	0.0570
0.003	0.012	0.0088	0.0115	0.046	0.0336	0.020	0.080	0.0584
0.0035	0.014	0.0102	0.012	0.048	0.0350	0.0205	0.082	0.0599
0.004	0.016	0.0117	0.0125	0.050	0.0365	0.021	0.084	0.0614
0.0045	0.018	0.0131	0.013	0.052	0.0380	0.0215	0.086	0.0628
0.005	0.020	0.0146	0.0135	0.054	0.0394	0.022	0.088	0.0643
0.0055	0.022	0.0161	0.014	0.056	0.0409	0.0225	0.090	0.0657
0.006	0.024	0.0175	0.0145	0.058	0.0423	0.023	0.092	0.0672
0.0065	0.026	0.0190	0.015	0.060	0.0438	0.0235	0.094	0.0686
0.007	0.028	0.0205	0.0155	0.062	0.0453	0.024	0.096	0.0702
0.0075	0.030	0.0219	0.016	0.064	0.0467	0.0245	0.098	0.0716
0.008	0.032	0.0234	0.0165	0.066	0.0482	.....	.....	.....
0.0085	0.034	0.0248	0.017	0.068	0.0497	.....	.....	.....

Example 2—A spur gear has 45 teeth of 10 diametral pitch, making the pitch diameter equal 4.5 inches. The pressure angle is 20 degrees. Determine measurement M for a gear cut without allowance for backlash.



The Dimension M is Required. Left Diagram Shows an Even Number of Teeth and Right Diagram an Odd Number

Table 1 shows that the value of Y equals 0.5695. The pin diameter for 10 diametral pitch (Table 2) equals 0.1680. The factor F for 45 teeth (Table 1) equals 1.0006. Then

$$M = \frac{\left(4.500 + \frac{0.5695}{10}\right)}{1.0006} + 0.1680 = 4.7222 \text{ inches}$$

If the circular pitch is given, first determine the equivalent diametral pitch and then proceed the same as for diametral-pitch spur gears. Table 2 includes circular pitches equivalent to the diametral pitches listed. To convert any other circular pitch to diametral pitch, divide 3.1416 by the circular pitch.

Diameter of Pins or Rolls

In measuring spur gears, the pin diameter in all cases must equal 1.68 divided by the diametral pitch. The pin diameters given in Table 2 are based upon this formula. In checking the sizes of helical gears (as explained later), the pin diameters must equal 1.68 divided by the normal diametral pitch.

Pin sizes conforming to the general rule given will contact slightly above the pitch line, so that in measuring gears having an allowance for backlash or play between the teeth, the pins will not drop below the tops of the teeth, thus interfering with over-all measurements. This slight departure from pitch-line contact will not affect the accuracy of the measurement. The pin diameter should be accurate within 0.0002 inch, in order to limit the error of the over-all pin measurement to approximately 0.001 inch.

In checking the sizes of helical gears, especially if the helix angles are large, it is advisable to use some form of measuring device equipped with balls or ball-shaped ends, because of the tendency of pins to rock or change their position. When balls are used, the diameter for a given diametral pitch is, of course, the same as for pins. When pins or rolls are applied to helical gears, it is important to remember that measurement M represents the minimum distance over these rolls.

Checking the Size of an External Helical Gear Having an Even Number of Teeth

First find, in Table 3, a factor C opposite the helix angle of the gear to be measured. Then multiply the number of helical gear teeth by this factor C, thus obtaining a number that is used in determining the Y value, which, for a helical gear, is indicated in the formula as Y_h. The procedure then is the same as for a spur gear, except that the normal diametral pitch is used. Formula (5) is for external helical gears having an even number of teeth.

Example—A helical gear has 32 teeth of 6 normal diametral pitch (if normal circular pitch were given, this would first be converted to normal diametral pitch). The helix angle of the gear is 23 degrees; the pitch diameter, 5.794 inches; and the normal pressure angle, 20 degrees. Determine measurement M without allowance for backlash.

Table 3 shows that factor C for a helix angle of 23 degrees equals 1.28. The product of $N \times C$ or 32×1.28 is 40.96; hence, the nearest whole number, or 41, is used in determining the Y value (Y_h for helical gears). Table 1 shows that this value equals 0.5675 for a pressure angle of 20 degrees. The pin diameter for 6 normal diametral pitch (see Table 2) equals 0.28 inch.

Then

$$M = 5.794 + \frac{0.5675}{6} + 0.2800 = 6.1686 \text{ inches}$$

When Number of Helical Gear Teeth is Odd

When a helical gear has an odd number of teeth, a factor F for the given number of teeth is inserted in the formula, the same as for spur gears having odd tooth numbers. For helical gears, however, the normal pitch is used, as previously explained, and the value Y_h determined as shown by the foregoing example. Formula (6) applies to external helical gears having an odd number of teeth.

Example—Assume that a helical gear has 13 teeth of 8 normal diametral pitch, a normal pressure angle of 14 1/2 degrees, a helix angle of 45 degrees, and a pitch diameter of 2.298 inches. Determine measurement M.

Factor C (Table 3) for 45 degrees = 2.83 and $2.83 \times 13 = 36.79$. The value of Y_h for the nearest whole number, or 37, is 0.5750. The factor F in Table 1 equals 1.0073 for 13 teeth. The pin diameter A for 8 normal diametral pitch (Table 2) equals 0.21.

Then

$$M = \frac{2.298 + \frac{0.5750}{8}}{1.0073} + 0.210 = 2.5627 \text{ inches}$$

Checking External Gears when There is an Allowance for Backlash

In the production of gearing, it is common practice to make the tooth thickness of either one or both mating gears slightly less than standard to provide a little clearance space or play between the teeth. In checking such gears by the pin method, first determine the measurement M for gears without backlash (as previously described) and then, for external gears, subtract from this measurement M an amount determined as follows: Find, in Table 4, opposite the required amount of backlash and under the pressure angle, a value B. If the required backlash is to be obtained by reducing the tooth thickness of one mating gear only, subtract from measurement M the value of B. If the teeth of both mating gears are to be reduced to obtain the required backlash, subtract from M an amount equal to one-half B.

Example—In a preceding example, the measurement M for a spur gear without allowance for backlash was found to be 10.5645 inches. The pressure angle is 14 1/2 degrees. Assume that, in this case, the desired amount of backlash is 0.008 inch and that this is to be obtained by reducing the tooth thickness of one mating gear only. Table 4 shows that allowance $B = 0.032$.

Then

$$M = 10.5645 - 0.032 = 10.5325 \text{ inches}$$

Checking Internal Spur and Helical Gears

The general procedure in checking internal spur and helical gears is the same as for external gears. Formulas (3), (4), (7) and (8) (see end of Table 1) differ only in regard to the substitution of certain minus signs for plus signs.

In checking internal gears with allowance for backlash, first determine measurement M for an internal gear without backlash and then add an amount B (obtained from Table 4), provided the backlash is to be secured by reducing the tooth thickness of one mating gear only. If the teeth of both mating gears are to be reduced, then add to measurement M one-half the amount B.

Checking Tooth Spacing and Profile

The accuracy of the tooth spacing and profile can be checked by taking measurements M at several points around a gear; thus, if measurement M does not remain constant when the pins are placed in different pairs of opposite tooth spaces, this indicates lack of uniformity either in tooth spacing, tooth thickness, or tooth profile.

The time-saving tables accompanying this article are based upon fundamental formulas in the "Manual of Gear Design," by Earle Buckingham, Professor of Mechanical Engineering, Massachusetts Institute of Technology.

Ball-Point Gear Micrometer

The heading illustration shows a ball-point micrometer designed by the author for measuring gears up to 6 inches pitch diameter. In using this micrometer, a ball point suitable in size for the gear to be measured is inserted in the micrometer spindle (the radius of this point = 0.84 ÷ diametral pitch, or by normal diametral pitch in the case of helical gears).

Next calculate dimension M as previously described and divide M by 2, thus obtaining the radial dimension which is measured by the micrometer. In finding dimension M, use the formula for an even number of teeth, whether the actual number is even or odd, as the dimension is radial.

Assume that $M \div 2 = 1.75$. First adjust the micrometer head to the decimal part of this dimension M, or to 0.75 in this case.

In the base of the micrometer, there are three equally spaced holes having a center-to-center distance of 1 inch. A stud upon which the gear is mounted is placed in one of these holes. As the dimension $M \div 2$ is 1.75, the stud should be placed in the hole nearest the micrometer head, as this is the position for diameters up to 2 inches. The center hole is for diameters from 2 to 4 inches, and the outer hole for diameters from 4 to 6 inches. The upper end of the stud fits closely into the shaft hole of the gear.

After withdrawing the micrometer spindle slide (against the resistance of a spring beneath the slide), mount the gear on the stud and allow the spring-operated slide to bring the ball point into contact with the gear.

If the hand of the indicator dial (below the micrometer spindle) is in the zero position when the ball point is in contact with the teeth, this shows that the gear size is correct. If the indicator hand swings to the left of the zero position, the gear is over size, and a movement to the right shows that the gear is under size by twice the amount directly indicated on the dial.

To check the concentricity of the gear or any deviation from the calculated dimension $M \div 2$, withdraw the micrometer spindle slide repeatedly and insert the ball point in various tooth spaces around the gear, noting any variations of the indicator hand from the zero position. The spring-operated slide insures a constant measuring pressure, so that uniformly accurate measurement does not depend on the skill or judgment of the one using the instrument.

If backlash is to be obtained by reducing the tooth thickness of one mating gear only, subtract an amount equal to one-half value B (Table 4) in using the ball-point gear micrometer. If the teeth of both mating gears are to be reduced, subtract one-fourth value B. For internal gears, these amounts are added, as previously explained.

Evolution of Spindle Noses

Spindle Noses Developed for Pratt & Whitney Engine Lathes Since 1882 Show Evolution of Principles Embodied in the New Standards for Spindle Noses which have Recently been Approved by the American Standards Association

By F. O. HOAGLAND, Master Mechanic
Pratt & Whitney Division Niles-Bement-Pond Co.,
Hartford, Conn.

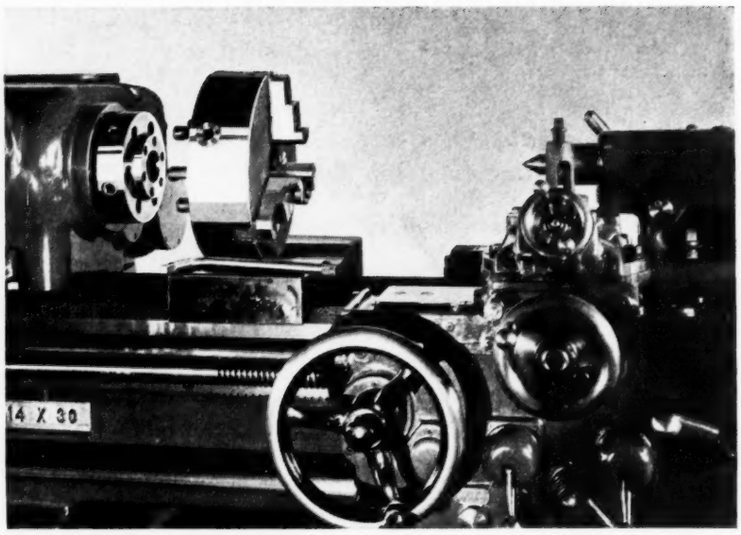


Fig. 1. Engine Lathe Equipped with American Standard Cam-lock Spindle Nose and Chuck in Position Ready for Mounting

DRAWINGS recording the developments in spindle noses for Pratt & Whitney engine lathes from 1882 up to 1928 show a gradual evolution of the principles of design incorporated in the new standards for lathe spindle noses, described in May, 1937, MACHINERY, page 598. While the new standards for spindle noses have been approved and accepted for turret lathes and automatic lathes only, they are now being applied to Pratt & Whitney engine lathes, as shown in Fig. 1, and to engine lathes of other makes.

A Pratt & Whitney 16-inch engine lathe spindle equipped with the American Standard cam-lock spindle nose is shown in Fig. 2. This spindle nose, when compared with the diagrams in Fig. 3 illustrating the step-by-step developments of Pratt & Whitney spindle noses, will show that its design is in accordance with the next logical step in this process of evolution.

Referring to Fig. 3, the spindle nose shown at *A* is the oldest design in the company's records, having been used on the Pratt & Whitney 18-inch engine lathe of 1882. The great length and the fine pitch of the threaded end and also the flange for holding the chuck or faceplate in the true running position are its outstanding characteristics.

The spindle nose for the 13-inch engine lathe of 1887, shown at *B*, is similar to the preceding one, but it has a cylindrical pilot added at the rear of the thread and in front of the flange shoulder. It will be noted that a small hole is drilled at the inner end of the thread to provide clearance for the point of the threading tool. This was quite a common practice in the early days.

On the spindle nose of the 10-inch engine lathe dated 1888, shown at *C*, the cylindrical pilot is placed in front of the thread, making it more convenient to mount the chuck or faceplate by allowing it to rest on the pilot until the thread is engaged.

The spindle nose of the 14-inch engine lathe dated 1899 has the cylindrical pilot at the front end lengthened and the thread transferred to the rim of the flange, as shown at *D*.

The spindle of the 16-inch engine lathe developed in 1921 had the spindle nose designed as shown at *E* with a tapered pilot. The reason for replacing the cylindrical pilot with a tapered one was that the mating hole in the chuck or faceplate seldom fitted the pilot close enough to insure accurate location or alignment. In this design, the flange has disappeared and the tapered pilot, hardened and

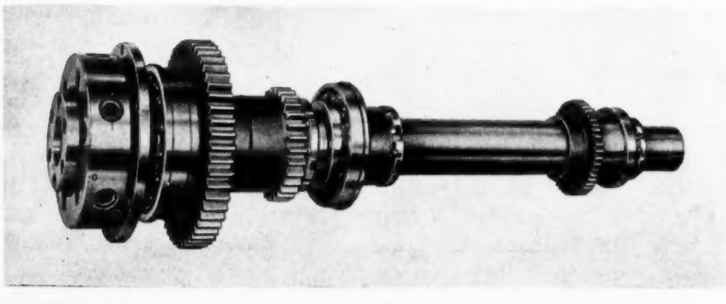


Fig. 2. Pratt & Whitney 16-inch Engine Lathe Spindle with the American Standard Cam-lock Spindle Nose

ground in order to retain its accuracy, serves as a shoulder for locating the chuck or faceplate. A thread of coarser pitch is also used to replace the finer threads, on which the faceplates had a tendency to freeze or stick. Great difficulty was often experienced in removing the chuck.

The substitution of a tapered pilot for the cylindrical pilot and the shoulder on the spindle nose, shown at *D*, improved the fit on the pilot, but in actual practice, it was found difficult to keep the threads clean or free from chips, which caused the faceplate or chuck to run out of true. A cylindrical pilot in back of the thread was, therefore, added to the spindle nose for the Pratt & Whitney 16-inch engine lathe of 1928. This spindle nose, shown at *F*, was hardened and ground inside and outside, including the threads, and the mating surfaces were held to very close limits to insure rigidity and interchangeability.

Up to this time, interchangeability of chucks and faceplates had been confined to engine lathes made by each individual manufacturer. Thus chucks could not be used interchangeably on different makes of engine lathes of different sizes. It was to meet this situation that the new standards were developed. These standards permit interchanging of the chucks, faceplates, and other work-holding means, not only on turret lathes, automatic lathes, engine lathes, and bench lathes, but also on a great many other machines of different types and makes.

In Fig. 2 is shown a Pratt & Whitney 16-inch engine lathe spindle equipped with an American Standard cam-lock spindle nose having a flange of generous proportions, and its driving gears and ball bearings ready for assembly. This new spindle nose combines the desirable features of the flanged shoulder and tapered pilot of previous designs shown in Fig. 3. The cam-locks in the spindle flange, and the cam studs in the faceplates and chucks for securely locking them to the spindle flange, have been substituted for the conventional threads. The mating members are easy to clean and to keep free from chips, a feature that greatly facilitates keeping a large faceplate running true. The conventional chuck plate has been eliminated and the body of the chuck has been bored out to fit the tapered pilot on the spindle end, thereby reducing the overhang and increasing rigidity.

With the new spindle nose, it is feasible to run the spindle at the higher speeds now employed, stop it quickly, and reverse it without danger of unscrewing the chuck or faceplate.

The mounting or removing of the chuck or faceplate can be done more easily than with the old style threaded spindle nose, as there are no threads to be engaged. Neither is it necessary to lock this spindle in a certain position to mount the chuck.

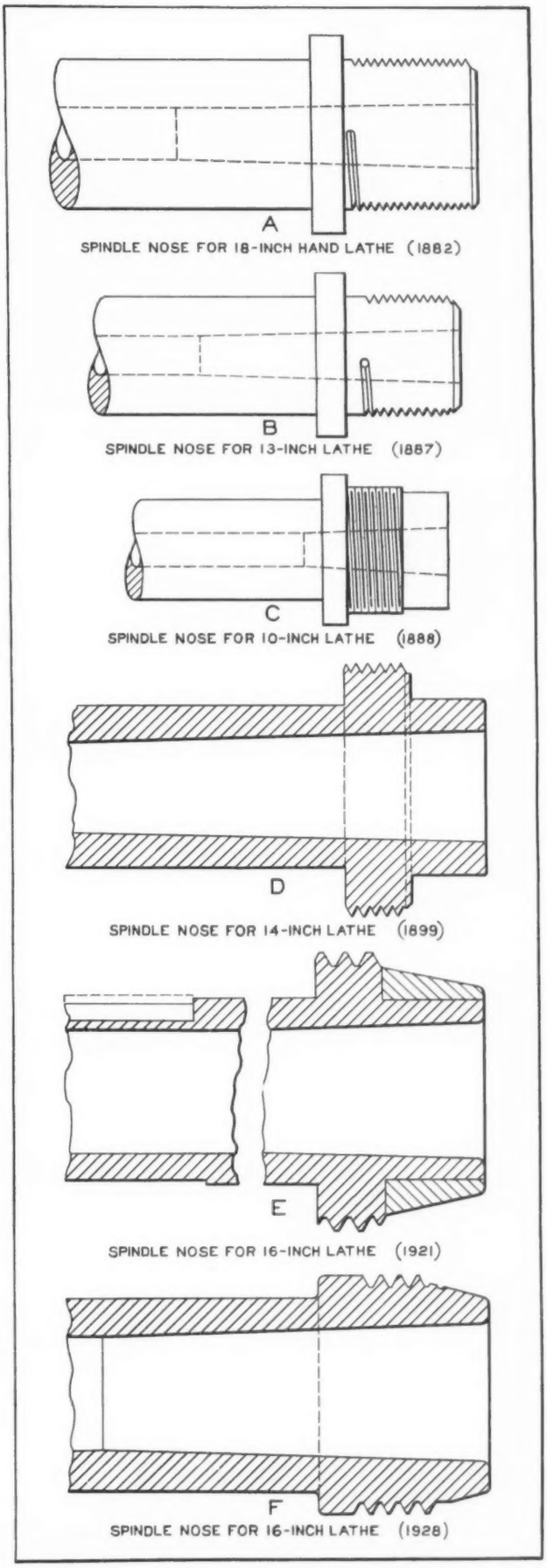


Fig. 3. Pratt & Whitney Spindle Nose Designs Developed from 1882 to 1928, Showing Gradual Evolution of Principles Embodied in New Standard Designs

Increasing Use of Chromium Steels in Industry

A SURVEY of the types of steel used in almost every important industry—automotive, aviation, railroad, mining, petroleum, chemical, food—indicates that chromium steels are more widely used than ever before. The tendency is to use more chromium steel for heat-resistant and corrosion-resistant applications, as well as for added strength in structural applications. Modifications in the chromium content and suitable additions of other alloying elements are making many of the chromium steels more valuable, more economical, and more widely applicable.

Modifications in the widely used 4 to 6 per cent chromium steels have added to this type of steel a molybdenum-bearing 9 per cent chromium steel suitable for severe service in petroleum refineries and power plants. For high-pressure service, where resistance to shock and the decarburizing effect of hydrogen at high temperature is required, good results are obtained with 1.50 to 2.75 per cent chromium and additions of molybdenum and vanadium. Another modification is a columbium-bearing 2 per cent chromium steel.

The addition of columbium or titanium is responsible for much of the improvement in the properties of many of the chromium-nickel and straight chromium steels, and is the most successful answer research has yet found to certain exacting demands of industry. The prime function of columbium appears to be the control of the carbide constituents of chromium steels. The columbium-bearing chromium steels have found especial application in products fabricated by welding.

Columbium is used in an 18-8 chromium-nickel stainless steel welding rod, and either columbium or titanium in stainless base metal, to inhibit any tendency toward intergranular corrosion that might otherwise be present in or near the welds.

Among the important modifications of the straight chromium oxidation-resistant steels is a new alloy containing 16 per cent chromium and 1 per cent nickel—an alloy that may be heat-treated after fabrication. This material is used in airplane construction.

The analyses of many heat-resistant steels containing 20 to 35 per cent chromium have also been modified. An alloy containing 35 per cent chromium and 7 per cent aluminum has recently been announced as suitable for continuous service at 2300 degrees F.

Another modification consists in the addition of nitrogen to improve the grain structure. Steel castings containing over 20 per cent chromium have been in use for many years in applications where resistance to corrosion, to high temperatures, and to excessive wear is desirable. The addition of nitrogen to such alloys has the effect not only of reducing the tendency to grain growth at high temperatures, but also of refining the grain. This results in a marked increase in the ultimate strength, yield point, elongation, and reduction of area. The nitrogen is added in the proportion of approximately one part to 120 parts of chromium. It is introduced in the form of high-nitrogen ferro-chrome.

Nitrogen is added to chromium steel ingots, as well as to castings, to impart a fine grain and produce a tough and ductile metal especially adaptable to deep drawing operations. Nitrogen-bearing high-chromium steel also appears to possess valuable characteristics for high-quality corrosion-resistant seamless tubing.

The older types of chromium steels aare also being used to an increasing extent. The automotive industry is an outstanding example. The aviation field and the railroads are also users of large quantities of such steel.

* * *

Pacific Coast Meeting of the American Welding Society

The Pacific Coast Section of the American Welding Society will hold a meeting in Los Angeles, Calif., in conjunction with the exposition and meeting sponsored by the American Society for Metals in that city, March 21 to 25. The meetings of the American Welding Society will be held at the Biltmore Hotel. The following subjects have been scheduled for papers or discussion: "Welded Piping for High-Temperature and High-Pressure Service"; "Design of Welded Connections in Building Construction"; "Welded Oil-Well Casings"; "Fabrication of Large Pipe for Water Transmission"; "Stainless Steel Welding"; "Fabrication for Machine Design." The meetings are open to all engineers, metallurgists, welders, and designers interested in the application of welding.

* * *

An Apprentice School with a Historical Background

The Brown & Sharpe Mfg. Co., Providence, R. I., has published an attractive folder containing group photographs of the 269 former graduates of the Brown & Sharpe apprentice training courses that are now connected with the company in various capacities—machinists, toolmakers, sub-foremen, assistant department foremen, department foremen, and engineering and works executives. Anyone interested can obtain a copy of this folder by applying to the Brown & Sharpe Mfg. Co.

* * *

Scrap Iron Definition—Scrap iron consists of odd pieces of iron and steel which are imported by nations engaged in a scrap.

Changing a Grinding and Polishing Department from Group to Individual Drive

By J. D. MILLER, Industrial Department
Westinghouse Electric & Mfg. Co.

THE replacing of group drives with individual motor drives has been going on for a number of years. In general, the flexibility of the individual motor drive appeals to the industrial engineer or plant manager. It is seldom, however, that an industrial plant is forced to dispense with a group drive in order to save the overhead structure, which happened in the plant of a manufacturer of agricultural machinery. In this plant, it was necessary to change the entire lay-out of the grinding and polishing equipment because the high-speed shafting driving the grinders and polishers caused excessive vibration in the building. This made it necessary to inspect and tighten all overhead equipment every three weeks.

Most of the machines were belt-driven, power being supplied by five group drives. Each group consisted of a 75-horsepower motor, driving a section of lineshafting operating at 500 revolutions per minute. Each section of lineshafting, in turn, drove eight grinders or polishers through countershafts. This high-speed lineshafting was essential in order to reduce the pulley sizes on the machine spindles. The speeds of the machine spindles ranged up to 1750 revolutions per minute.

A study of the vibration problems disclosed that enough metallic dust and dirt collected on the lineshaft pulleys to cause an unbalance of the high-speed shafting, which set up excessive vibration in the building. In spite of frequent inspections, the vibration became so pronounced that it was necessary to take out an installation of Cooper-Hewitt lights. Finally, the management decided to install individual motor drives.

The new arrangement required 31 motors ranging in size from 7 1/2 to 20 horsepower. Motors running at 1750 revolutions per minute were selected to provide a 1-to-1 ratio for individually driving each machine. The motors were mounted on the ceiling, directly above the machines, driving the machines with flat belts. This arrangement, with the elimination of all high-speed lineshafting and countershafts, has reduced the maintenance labor required for general building inspection, oiling, belt repairs, and replacements. Elimination of the lineshafting and countershafts improved the general lighting considerably, which was an important point to the men operating the polishers and grinders.

The motors selected were fan-cooled and totally enclosed. Combination line starters with non-fusible motor circuit switches were used to control each motor. In addition, three Nofuze convertible distribution panelboards were installed, so that individual feeder circuits could be run to each motor.

Considerable study was given to the type of electrical equipment selected, as this installation had to prove its value in dollars and cents. The choice of totally enclosed fan-cooled motors and Nofuze panelboards was made to insure a reduction of maintenance labor and a minimum of possible interruption of production.

With the installation of the Nofuze panelboards, lost machine hours and lost man hours were cut down to a minimum, due to the fact that the machine operator could restore service immediately by resetting the De-Ion circuit-breaker. Under the old arrangement, a "fuse outage" meant considerable loss in production, for the shutdown of one 75-horsepower motor meant that eight machines were out of use until new fuses or fuse links were installed by the electrician. The features of the De-Ion breakers have proved themselves so desirable to the management that De-Ion breakers are being used throughout the plant wherever possible.

At the same time that the group drives were changed over to individual drives, a new type of dust collector was installed, cutting the horsepower for the dust-collecting system from 235 to 75. This saving, plus about $7000 worth of transmission fittings salvaged from the high-speed lineshafting, which were of the anti-friction type, was credited against the new installation.

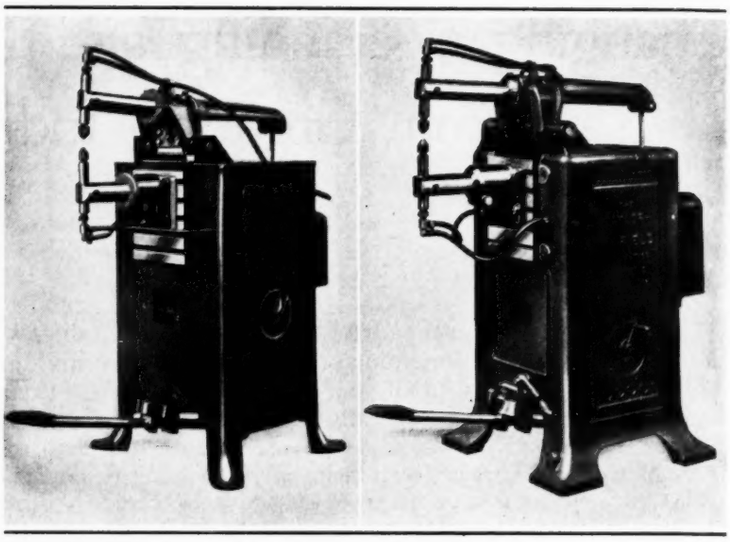
The rearrangement of machines permitted by the use of individual motor drives provided a saving in floor space of about 12,000 square feet. The assembly, grinding and finishing departments were combined in a building formerly occupied by the grinding and polishing machines alone. This additional saving was also credited against the new installation.

* * *

Profitable business is essentially the furnishing of something to somebody else which is worth more to that person than it is to the man that produced it. The making of a profit is not a disgrace; it is a badge of service, showing that in the judgment of those who have cast their dollar votes, the possession of a particular article is worth more to them than the money they are exchanging for it. They have said, in effect, that they are better off through the activity of the man who made that article or rendered that service.—*S. Wells Utley, president, Detroit Steel Casting Co.*

Welding Frames of Welding Machines

By
J. H. COOPER
Welding Engineer



Figs. 1 and 2. Welded Frame (Left) Compared with Cast Frame (Right)

FEW processes are used as extensively by the manufacturers who themselves produce equipment for the process as are the various types of welding. Leading manufacturers of arc-welding machines produce the frames of motors and other welding equipment by welding. It is also interesting to note that the frames of a standard line of resistance welding machines are also fabricated entirely by arc welding to obtain a more economical product of a better quality. This is done by the Taylor-Winfield Corporation at its fabricating plant at Detroit, Mich., where welding machines of the type shown in the accompanying illustrations are now provided with welded frames.

Until a little over a year ago, the welding machine shown was assembled into a cast-iron frame, as indicated in Fig. 2. This frame contains large areas of comparatively thin sections. There are no particularly exacting requirements as to strength and rigidity, but the machine must have a pleasing appearance. Being convinced of the advantages of a fabricated welded frame, the company developed such a design. Fabricated rolled plate, with its smooth surfaces, ductility, uniformity of thickness in thin sections, and freedom from casting difficulties, had obvious advantages, provided the cost of welding as compared with casting would offer no objections.

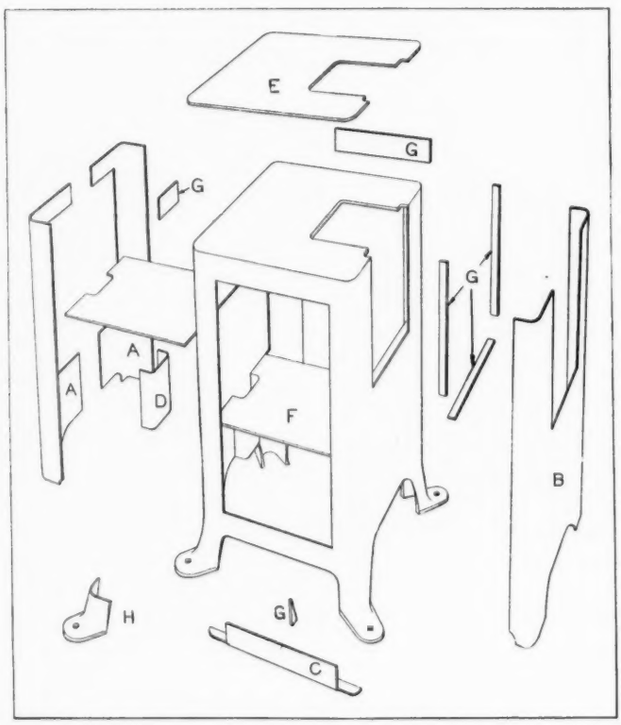


Fig. 3. Welded Frame and Parts Used in its Construction

A design was worked out and permanent metal templets were made up for gas-cutting the main side pieces *A* and *B*, Fig. 3, for the frame. These pieces were gas-cut to shape and then bent to shape by dies in a press type brake. The same procedure was followed for the frame cross-bars *C* and other parts. Clearance channel *D* was sheared to size and bent to shape as shown. The top plate *E* and the transformer support plate *F* were also gas-cut, and reinforcing bars and gusset plates *G* were sheared from scrap or bar stock. The four feet *H* were made from steel castings, as the shape desired was not adapted for economical forming and fabrication by welding.

After the material had been prepared as outlined, the parts were assembled by tack-welding with the electric arc in assembly jigs and fixtures. Following this assembly, the frames were sent to the welding line where all the arc welding was done with high-speed, heavily coated fluxed electrodes. Alternating-current welding was used.

After welding, the frames were ground and polished with portable air-driven grinding wheels, and buffed to a final finish by the use of a wire buffing wheel. Inspection, drilling, and spraying with paint completed the series of operations on the frame, preparing it for the final assembly of the resistance welding machine.

A lot of 200 fabricated frames in two slightly different sizes was put through production, and a cost analysis was made, comparing costs with those of the previously used cast-iron frames, also made in large lots. The cast-iron frame costs, of course, included pattern charges.

It was found that the weight of the smaller cast-iron frame was 140 per cent greater than that of the smaller fabricated frame, and that the weight of the larger cast-iron frame was 325 per cent greater than that of the larger fabricated frame. The use of thin steel sections instead of thicker cast-iron sections accounted for the reduction in weight. The total cost of the smaller cast-iron frame was 66 per cent greater than that of the smaller fabricated frame, and the cost was 228 per cent greater in the case of the larger size.

The machining cost of the small cast-iron frame was 300 per cent greater than that of the smaller welded frame, and the cost was 275 per cent greater in the case of the larger frame. The saving in machining costs was largely due to the elimination of certain machining in the welded frames, through the punching of holes in the steel plates before they were assembled into the frames, and to the fact that there was no need for spot facing, as there was in the case of the rough castings.

It should be noted that these savings of welded frames over cast frames are larger than those usually obtained, because of the large thin, flat sections met with in this case. Whenever the substitution of welding for casting is contemplated, an impartial analysis should be made, so that each case may be judged on its merits and the best process selected. As indicated by the use of the cast feet on the fabricated frame, the final result may be a satisfactory compromise.

* * *

The cast-iron crankcase of an 8-ton, 36-inch gage, gasoline-engine driven locomotive became fractured. The damage was repaired by bronze-welding. Since that time, the locomotive has been in service for over five years, the welding job having given perfect satisfaction. The locomotive is subjected to severe working conditions in a mountainous district. The cost of the repairs was less than one-fourth the cost of a new casting. The repair work was performed in three days, after which the locomotive was back in operation again.

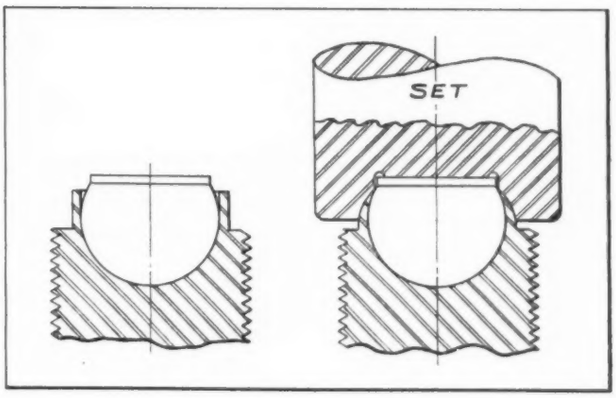


Fig. 1. Method of Staking Ball in Socket

Staking Ball Socket to Definite Tension

The problem of staking or crimping the edge of the precisely machined ball socket shown to the left in Fig. 1, so that the two-thirds ball would move freely but without any perceptible shake, was solved by using a High-Speed riveting hammer equipped with a cupped out "set," as shown in the view to the right. A machine with a definite length of ram travel could not be employed for this job because it pinched the ball too tightly in some cases and not tightly enough in others.

The method of handling the staking operation on the High-Speed riveting hammer made by the High Speed Hammer Co., Rochester, N. Y., is shown in Fig. 2. The separate "set," which is held in the hand, is cupped out sufficiently to fold the edge of the socket rim. The "set" is guided at the bottom by the work and at the top by the V-block. The pein of the riveting machine strikes the top of the "set."

An important feature of this "set" is the flat surface which engages the flat top of the ball and thus limits its downward travel. Since the ball and socket are machined to precise dimensions, this method of limiting the downward stroke of the "set" has proved satisfactory in obtaining just the right amount of tension without requiring the operator to exercise particular care in handling the work. The total time for this staking job is approximately two seconds.

Fig. 2. Ball-staking on a High-Speed Riveting Hammer

Plastics as Basic Materials in Machine Design

By H. S. SPENCER
General Plastics, Inc., North Tonawanda, N. Y.

DURING the last half-dozen years, plastics have been quietly emerging from the knob-and-insulator stage into a full-fledged engineering material, ranking with metals in their importance to designers. No radical developments account for this change; it has been merely a gradual improvement, going hand in hand with a growing realization among designers that molded parts can safely be used where metal, ceramic, and wood parts formerly were specified.

Take, as an example, the latest Hoover vacuum cleaner. Six years ago, the only plastic parts used on vacuum cleaners were cord plugs, switch buttons, and the like. Today twenty-one parts of the latest Hoover model—ranging from motor housing and hood to cleaning tools—are molded from phenolic plastics. They are structural parts, parts subjected to rough usage, vibration, and hard knocks against radiators, and yet the material of which they are made has an impact strength no greater than compounds that have been on the market four or five years. To be sure, plastic materials are improving, but, perhaps, not so fast as the attitude of designers toward their use.

A New Hoover Vacuum Cleaner, the Weight of which was Reduced Several Pounds by the Use of Thirteen Molded Plastic Parts and by Using Magnesium-alloy Castings. The Molded Parts Muffle Motor Noise and the Molded Motor Hood Saves Thousands of Dollars in the Cost of Factory Refinishing of Scratched Metal Hoods. Motor Housing, Connector Parts, and Crevice Tool are Molded of Special Black Durez

Today, the engineer may take two views of plastics. One is something like this: "Yes, plastics are interesting, but we will wait until they are stronger." The other is: "Let us design our parts now to compensate for any weaknesses plastics may have, and obtain their advantages today." The former view may be either lazy or over-cautious, but the result is that a manufacturer with this attitude may be missing definite advantages which plastics could bring to his product.

Advantages Gained by the Use of Plastics

The advantages obtainable with plastic materials may be divided into two groups. The consumer advantages include light weight (half the weight of aluminum); a chip-proof, scuff-proof luster; non-resonance; non-conductance of electricity; pleasing-to-touch surface; and resistance to peeling, checking, moisture, heat, acids, alkalies, and greases—all "talkable" sales arguments.

The engineering advantages are self-insulation; lower shipping weight; elimination of grinding, spraying, and baking operations; reduction of finish rejections and damage to finish in shipping; and when the quantities are sizeable, production economy—all of which may result in lower costs. In many instances, such as in the Hoover cleaner mentioned, there are both lower production costs and convincing sales arguments—an excellent formula for profits.

Precautions for Designers

Engineers planning their first structural uses of molded plastics must keep certain fundamental facts in mind, for while plastics have joined the basic material group, they cannot be handled like metals. The impact strength of even the stronger phenolic plastics is considerably below that of aluminum or magnesium alloys, and the tensile strength is about one-tenth that of stamped steel.

Hence, it is evident that a different approach must be adopted if one is to obtain successful molded structural parts. Different shapes of greater inherent strength should be used, wall thicknesses should be greater, and unsupported sections should be reinforced. A list of hints for designers of structural plastic parts follows:

Use corner fillets and filleted inside ribs on heavy-duty housings.

Put attachment inserts at filleted corners of box-like shapes, if possible, thus strengthening the piece and keeping flow-marks where they show the least.

Allow extra wall thickness at stress points or use reinforcing ribs or beads.

Use domed shapes instead of flat-topped forms, because they are stronger, owing to the fact that impact stresses are more widely distributed.

Fillet inside corners and "break" outside corners to aid the flow of material in the mold. This contributes to the strength. Also, cleaning of food equipment parts, for instance, is facilitated.

Provide large radii, as these give greater strength than sharp corners and make for ease of molding.

Check carefully with your molder and material supplier to get the compound best suited in strength and other properties to your application.

Broad Applications of Present Plastic Materials

Many other rules could be included for specific problems, but when engineers follow these general hints, plus their own common sense, successful plastic moldings usually result. One cannot, however, underestimate the importance of getting the proper molding material, for careful selection of compounds has made several jobs successful that were considered impracticable by other manufacturers. To show some of the varieties of phenolic molding materials available, the major groupings of one supplier are listed:

General Purpose	Closure Type
Non-bleeding	Moisture-resistant
Heat-resistant	High Dielectric
Extrusion Type	Acid-, Alkali-resistant
High Impact	Friction-resistant
Arc-resistant	Sanding, Buffing Type

An actual instance where thorough investigation of the plastic field made success out of failure can be found in the rayon machinery industry. One manufacturer of equipment was looking for a lightweight material that could be fabricated into very intricate pieces and would resist the effect of moisture and the chemicals used in rayon production without corrosion or "bleeding." Furthermore, the frictional wear should not affect any of these properties, nor could the slightest roughness be tolerated which would damage the delicate fibers. Obviously, a non-metallic material was called for, because of the corrosion problem and the light weight. A search revealed that only one plastic manufacturer could supply a material satisfactory in every respect. A cursory survey might have failed to reveal this one material.

Plastics in 1938 Automobiles

Somewhat similar is the story behind some of the plastic dash panels used on the 1938 motor cars. A year or two ago several body designers vetoed the idea of molded panels, saying that the metal panels were integral parts of the body section and that only a plastic as strong as stamped steel could be used. Some engineers did not agree, and started work on adapting the body construction to take a non-stressed type of plastic dash, which today is proving successful on many cars.

The phenolic materials finally selected were not the highest strength grades (A.S.T.M. impact strength 0.28—0.70 FP), which have a tendency toward ripply surface luster and are rather costly, but materials with medium impact strength, higher luster, and greater ease of molding. Strength was imparted to the moldings entirely by design, which, instead of resembling the flat metal panels, tended to assume deeper, domed, and hemispheric shapes. A greater range of colors and lower material costs were other advantages gained.

Plastic Parts Must be Designed for Their Specific Purpose

A classic example of how careful design produces more successful moldings is furnished by a manufacturer of telephones who experienced some breakage of the hand-set arm when dropped on concrete floors. Redesign was decided upon, several parts were eliminated, and weak sections were strengthened by a rib blended into the design. In the new experimental mold, it was found that the high-impact phenolic compound formerly used was not necessary, and that a less expensive but more glossy material could be used. The result was a stronger, simpler, less expensive telephone set.

So, while molded plastics join metal, rubber, wood, and glass in the modern engineer's material handbook, his blueprints never should read: "Steel stamping or molded plastic." More difficulties can be traced to handing metal-part blueprints to molded-part salesmen for quotations than to any other one factor. The most successful plastic applications are those engineered from the ground up, with this one material in mind.

* * *

All producers are consumers, and consumers are producers, directly or indirectly. The few exceptions to this rule are negligible and do not alter the fact that a business policy or a government policy, to be sound, must see people not as antagonistic groups of producers and consumers, but as one group of producer-consumers, whose production of goods and services is necessarily prior to their consumption.—*Industrial Canada*

Malleable Iron in Present Engineering Practice

By Professor ENRIQUE TOUCEDA
Consulting Engineer
Malleable Founders' Society

IMPROVEMENTS in malleable foundry practice and in annealing and melting equipment, as well as the higher standards adopted during the past decade, have been responsible for the development of wider markets for malleable iron and a more complete understanding of the fields to which this material is particularly adapted.

Briefly, malleable iron is a high-grade iron alloy which has been subjected to a heat-treatment that removes internal strains and produces chemical and physical structures quite different from those of either gray-iron castings, steel castings, or steel forgings.

Malleable iron can be more readily machined than other ferrous metals of equal tensile strength, and it has greater resistance to corrosion than any other ferrous metal which is adaptable to the same uses, with the exception of specially developed alloy products. These properties provide important advantages when the use of this material is considered.

Beyond these features, malleable iron has an unusually high yield point—about 36,000 pounds per square inch—which exceeds the yield point of any ferrous material of equal machineability and rust-resisting properties. In addition, it offers a high resistance to shock, due to its inherent toughness. As evidence of its ability to resist sudden or repeated blows without fracture, it may be mentioned that many of the parts of automobiles and trucks in which safety is vitally important are made of malleable castings. These include differential and steering gear housings, hub parts, spring hangers, brake pedals, and other heavy-duty parts. The chief reason for the safety of malleable iron in parts such as those used in automobiles or trucks is that, when subjected to a severe blow beyond its yield point, as, for example, in an accident, it will stand serious distortion prior to fracture.

When machined properly, malleable iron presents a smooth, flawless surface with no deterioration in its mechanical properties. In many cases, the castings require no machining, due to the fact that they conform closely to the pattern, and the surfaces of the finished castings after cleaning are smooth and even. Improved foundry practice has done much

Fig. 1. Malleable Casting Made in One Piece, Indicating the Intricate Design Possible with This Type of Casting. This Gear and Worm are Part of a Railway-car Power Brake. The Casting is Used without Any Machining, Indicating the Accuracy that can be Obtained in Malleable Iron

Fig. 2. A 342-pound Armature Spider for a Large Electric Mine Locomotive Motor. Fig. 3. A Malleable-iron Tie Plate that has been in Service about Twenty-four Years. It will be Noted that the Corrosion has been Slight, Since the Pattern Number on the Casting is Still Clearly Legible

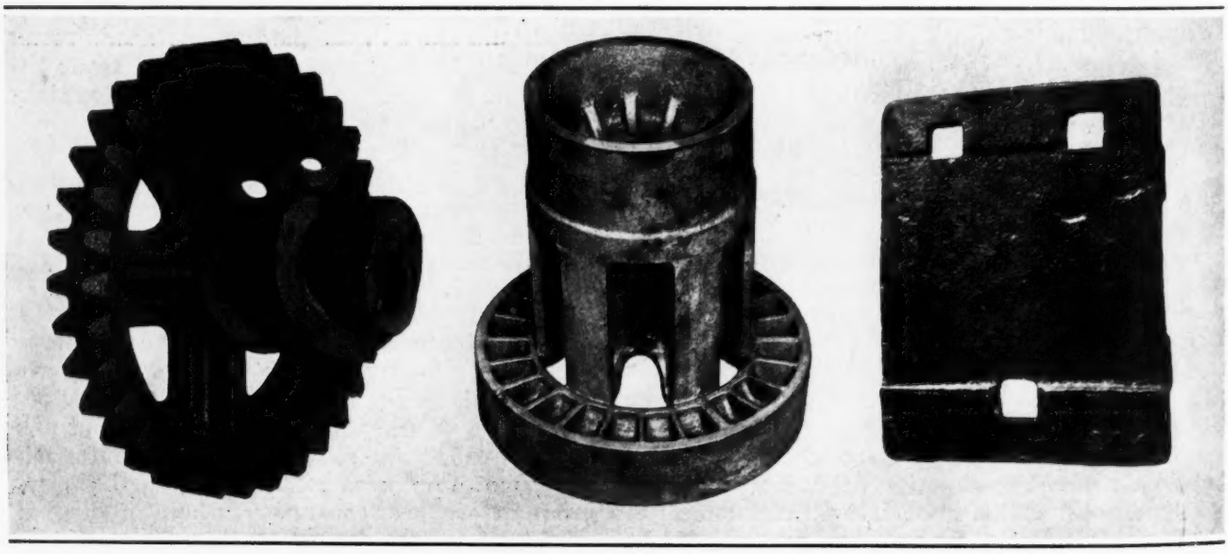


Fig. 1 Fig. 2 Fig. 3

to provide a better finish. The unmachined surfaces of malleable iron can be readily painted, galvanized, or plated.

Thin and intricate designs can be cast without difficulty. Castings may be of very light sections and may be made in sizes varying in weight from a fraction of an ounce to hundreds of pounds. In assemblies, and to avoid the drilling of holes, malleable iron can be readily punched or drifted, with the danger of the development of cracks reduced to a minimum.

The combination of high yield point, shock resistance, machineability, and corrosion resistance has resulted in a wide diversification of uses for malleable iron, ranging from moving parts and shock resisting parts to applications where durability is the main factor involved. Thus, in addition to automobile, railroad, and machinery uses, malleable castings are used as bridge railings, curb guards, pole line hardware, standards in stadium and park seats, and in almost every field where metal has an application.

Indicative of the constant improvement in quality, the standard specifications of the American Society for Testing Materials in 1915 called for 38,000 pounds tensile strength and 5 per cent elongation. Since 1915, the Society has increased the values in its specifications five times. During this interval, the minimum requirement for tensile strength has been increased from an average of 38,000 to 55,000 pounds, and the elongation from an average of 5 to 18 per cent. The present minimum yield point is 66 2/3 per cent of the tensile strength, an unusually high value.

The products of many foundries show even higher physical properties. For instance, the results of recent tests of 5000 bars representing products of 52 plants, as published by the American Society for Testing Materials, show the following average physical properties: Tensile strength, 54,032 pounds per square inch; yield point, 36,603 pounds per square inch; and elongation, 19.3 per cent in 2 inches.

These results are indicative of the ability of a large group of foundries to make a product, the average quality of which is considerably above the standard specifications. Of these, a large number are, therefore, prepared to fill orders on the basis of a minimum standard test specification of 55,000 pounds ultimate strength, 35,000 pounds yield point, and 18 per cent elongation.

* * *

Machinery Exports Continue at High Level

The United States exports of industrial machinery in November, the last month for which complete statistics are available, totaled approximately $21,400,000, representing a gain of 58 per cent over the corresponding shipments a year ago, valued at $13,535,000, according to figures published by the Machinery Division of the United States Department of Commerce.

By an odd coincidence, the increase in the exports of power-driven metal-working machinery was also 58 per cent, as compared with the corresponding shipments in 1936, the increase being the same as for the entire industrial machinery group. The foreign sales of power-driven machinery for November totaled $5,990,000, while the corresponding shipments in November, 1936, amounted to only $3,785,000. The exports of engine and turret lathes were doubled, and there were outstanding increases in thread-cutting machines, milling machines, gear-cutting machines, and drilling machines.

In the metal-working machinery group are also included foundry and molding equipment and rolling mill machinery, both of which showed increases, especially the rolling mill machinery group.

A Battery of Machines Designed for Testing to Destruction, under Radial and Thrust Loads, Tapered Roller Bearings up to 8 Inches Outside Diameter in the Testing Laboratory of the Timken Roller Bearing Co. The Bearings are Loaded in These Machines by Hydraulic Pressure, Oil Being Supplied at 1800 Pounds per Square Inch

Engineering News Flashes

The World Over

Photographic Exposures of Less Than 1/150,000 Second

At the International Aeronautical Exhibition in Milan, Italy, held last fall, the German Askania Werke A.G., exhibited a camera with a long-focus mirror objective and what might be called a "multiple-camera" having twelve objectives arranged in a circle. By means of a motor-driven rotating shutter it is claimed that exposures as brief as 1/150,000 second can be made, so that phenomena of very short duration can be photographed.

New Process of Heat-Treating Carbon Steel

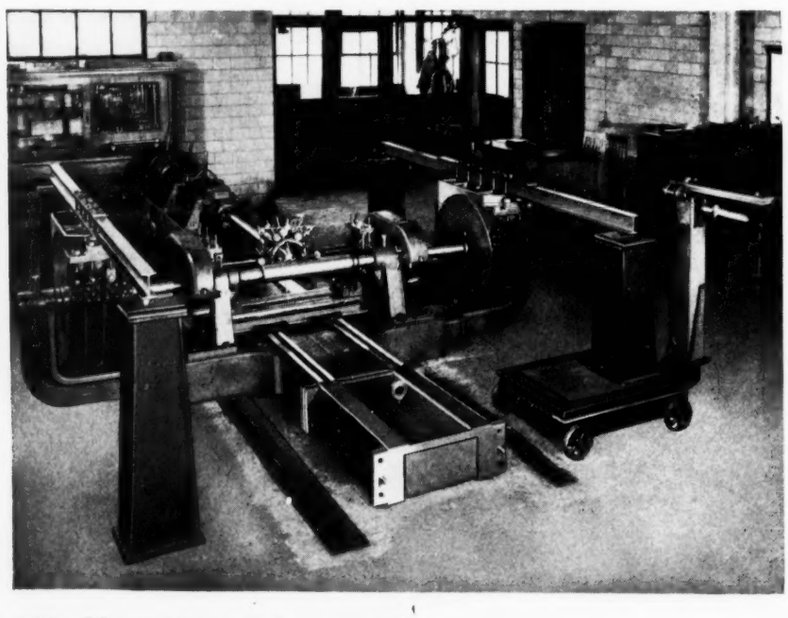
At a recent meeting of the Science Forum of the New York Electrical Society, Edmund S. Davenport, metallurgist of the United States Steel Corporation, briefly outlined the results obtained by a new process of heat-treating carbon steel that is now nearing a stage of practical use. The purpose is to obtain alloy steel properties in carbon steel. The process is known as "austempering."

According to Mr. Davenport, carbon steel which, when hardened and tempered by the usual methods, will snap when it is bent, acquires very different properties in this respect when "austempered." Having been subjected to that treatment, it is possible to obtain the same hardness as by the usual methods, but the treated steel can be bent to almost any desired angle. The essence of the process is said to be the quenching of the steel in a bath of molten salts of a character that will cool the steel quickly without combining chemically with the product. The mechanical industries will eagerly look forward to additional information on this method when it has progressed beyond the laboratory stage.

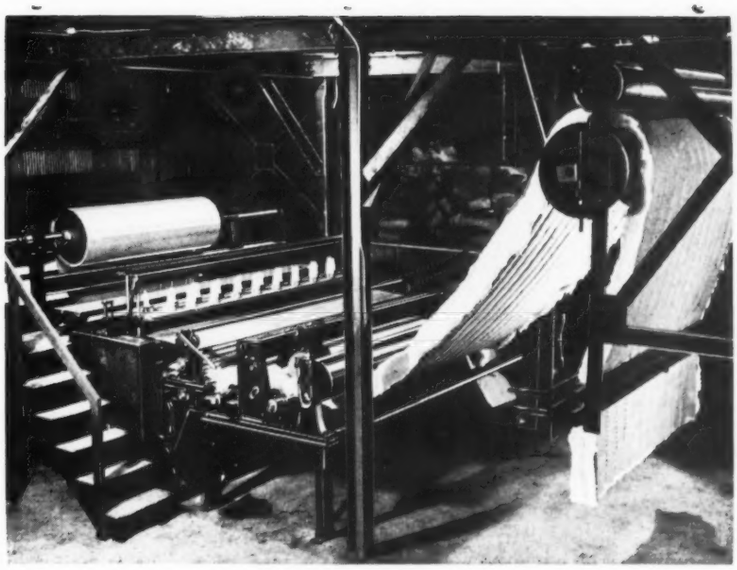
Traffic Control by an Electrical Master Mind

A most ingenious traffic control system has recently been installed in and around Piccadilly Circus, London, England. This system automatically does the work of some twenty policemen through a most ingenious control of thirty-eight interlocked traffic lights. Piccadilly Circus has six busy traffic arteries leading into it, with two additional intersections only a few yards away. It is believed to present the most complex traffic problem in the world.

The volume of traffic passing points on the streets entering into the Circus is measured automatically, and the green and red lights go on and



The Testing Machine Used in the Laboratory of the Timken Roller Bearing Co. for Determining the Deflections of Automotive Rear Axles. Loads up to the Maximum Low-gear Torque are Used for Deflection Tests. The Axles can be Tested to Destruction to Find the Weakest Part of the Design



A Machine Claimed to be the World's Largest Sewing Machine, Used in the Corning Glass Works, Corning, N. Y., for Stitching Blankets of Fibrous Glass, 9 Feet Wide and 5 Inches Thick. These Glass Blankets, Soft as Wool yet Absolutely Fireproof, are Used as Insulation for Railroad Cars, Buses, and Trucks, and in Smaller Sizes for Hot-water Heaters and Air Ducts

off accordingly. Three electrical "reporters" are installed at the entrance of three of the busiest streets leading into Piccadilly Circus. Their function is to record the density of traffic at each of these points, by measuring the length of the gaps between vehicles. If there are comparatively long gaps, a signal passes automatically to the "master mind," which promptly cuts down the green time at that point, changing to red. If the traffic is particularly heavy at another point, the automatic reporter informs the "master mind," and additional green time is allowed for that street. The lights are handled automatically at all other control points in the system, in a similar manner. By this means, it is hoped to provide a continuous flow of traffic and to cause the minimum amount of delay in driving. Fifty thousand vehicles will be controlled in this manner every twelve hours. This is equivalent to seventy a minute, but obviously the traffic is much heavier than that during rush hours.

Ingenious Post Office Scale for Parcels Post

A highly developed parcel-post scale has been designed by the Toledo Scale Co., Toledo, Ohio. The unusual feature is the manner in which the postage for any given weight of package and postal zone may be read off directly. The correct figures for the postage appear on the front of the scale in large, sharply lighted figures. There is only one set of figures to be read for any one zone at any one time. The figures can be read 15 feet away.

A 75-Ton Road Truck Trailer

One frequently hears the expression "running freight cars on the streets" used in this country in referring to the large trucks used especially in inter-city express service; but we have nothing in this country running on our regular roads compared with what has recently been built in England, where a 75-ton road trailer was constructed a short time ago by R. A. Dyson & Co., Ltd., of Liverpool, for transporting parts for the new sister ship to the *Queen Mary* now being built. This vehicle has a nominal load capacity of 75 tons and is one of the largest trailers, if not the largest, ever constructed for use on regular roads. The over-all length is 34 feet and the over-all width 9 feet. The vehicle is equipped with twelve wheels, each wheel being fitted with twin tires about 31 by 7 inches.

The Magnitude of Industrial Research

Some figures recently collected by the United States Steel Corporation indicate the tremendous activity in industrial research at the present time and the important part that the large industrial corporations play in research. According to the information published, the steel corporation has 174 laboratory departments throughout its works, grouped into 89 organizations in 64 different laboratory buildings. On these laboratories, $8,400,000 was expended in 1937. If concentrated in one building, the total floor space of all these laboratories would be equivalent to a forty-story building, 50 by 200 feet.

World's Largest Diesel-Electric Locomotive

The Union Pacific Railroad's newest streamline Diesel-electric locomotive is now in regular service between Chicago and Los Angeles, hauling a fourteen-car train between the two cities in somewhat less than forty hours. The three-unit 5400-horsepower locomotive is the largest of this type yet built. It is capable of hauling a fourteen-car train at a speed of 117 miles per hour on level track. General Electric motors and control equipment are used in the construction of this locomotive.

EDITORIAL COMMENT

A Foreman's View on the Training of Foremen

Commenting upon the editorial in December MACHINERY, page 240, dealing with foremen's training, a foreman writes: "Your editorial is very much to the point. If it takes four years' apprenticeship to instruct a young man to become a toolmaker and to teach him to do his work properly, why should a man be appointed foreman without any previous experience and training in the work he is expected to do? Why should he be assumed to know, without instruction, how to handle his job? Yet in a great many cases he is. True enough, he has learned a great deal by observation. During his years as journeyman, he has seen both the good points of the foremen under which he has worked and their mistakes. Still it is not reasonable to assume that the foreman's job is so much simpler than the toolmaker's that the former can be learned by observation, while the latter requires years of instruction."

Probably most men in industry will agree with our correspondent. Of late, management in the mechanical industries has given considerable thought to this subject, and in many instances, foremen are now being definitely trained for their jobs. Nevertheless, it is true that most shops probably still follow the time-honored—or should we say time-worn—custom in this respect, hoping that the inborn ability and good sense of the man made foreman will teach him to handle men while he is taking care of the mechanical duties as well.

Suppose that whenever a man is promoted from the ranks to the position of foreman, the management asks itself the question, "If it takes four years to train a toolmaker, how long does it take to train a foreman?" It is well worth pondering the answer to this question. If correctly answered, it may help to eliminate some of the misunderstandings that so frequently arise between employes and management, misunderstandings that a capable foreman can very often minimize or prevent.

Commendable Work Done by the Safety Engineer

The Safety Congress held last fall in Kansas City, Mo., under the auspices of the National Safety Council, demonstrated the great progress that has been made in the promotion of safe working conditions in industry, and emphasized the growing interest in the application of safety appliances during the last twenty-five years. The Congress was attended by more than 8000 delegates from every part of the United States and from several foreign countries. In addition, the annual exhibition of safety appliances, held in conjunction with the Congress, which covered more than 40,000 square feet of floor space attracted a very large number of visitors.

The industrial safety movement was first started by a number of men engaged in engineering work who felt that the hardships to workers and their families caused by preventable accidents were of a character that demanded definite action on the part of management. They pointed out that accident prevention was not only a humanitarian matter, but that fewer accidents meant reduced losses, in actual dollars and cents, both to the workers and to industry. In other words, they emphasized the fact that in this, as in many other instances, the right thing to do was also the profitable thing to do.

The result has been that no safety engineer today needs make any apologies for the expenses connected with the installation of safety appliances and with safety work in general, because these expenses are more than compensated for by the savings effected. At the same time, much unnecessary suffering and worry caused by industrial accidents have been done away with.

Frequently, well meaning people unfamiliar with industrial operations as carried on today in manufacturing establishments, burst into print, lamenting the dangers surrounding the factory worker. They draw a picture that is based largely upon their own imagination or prejudices. Other writers, seeking the sensational, have presented the working conditions in industry in a manner completely contrary to the truth.

As a matter of fact, due to the work of the industrial safety engineer, industrial accidents today constitute a very small percentage of the total accidents recorded throughout the nation. Of course, the automobile is responsible for the largest number of severe accidents; next to these, those that happen right in the home or on the farm constitute the largest percentage. The safety engineer is to be congratulated upon the fact that he has reduced accidents in industry to a much greater degree than has been done in other walks of life. He has filled his place to the satisfaction of all concerned.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

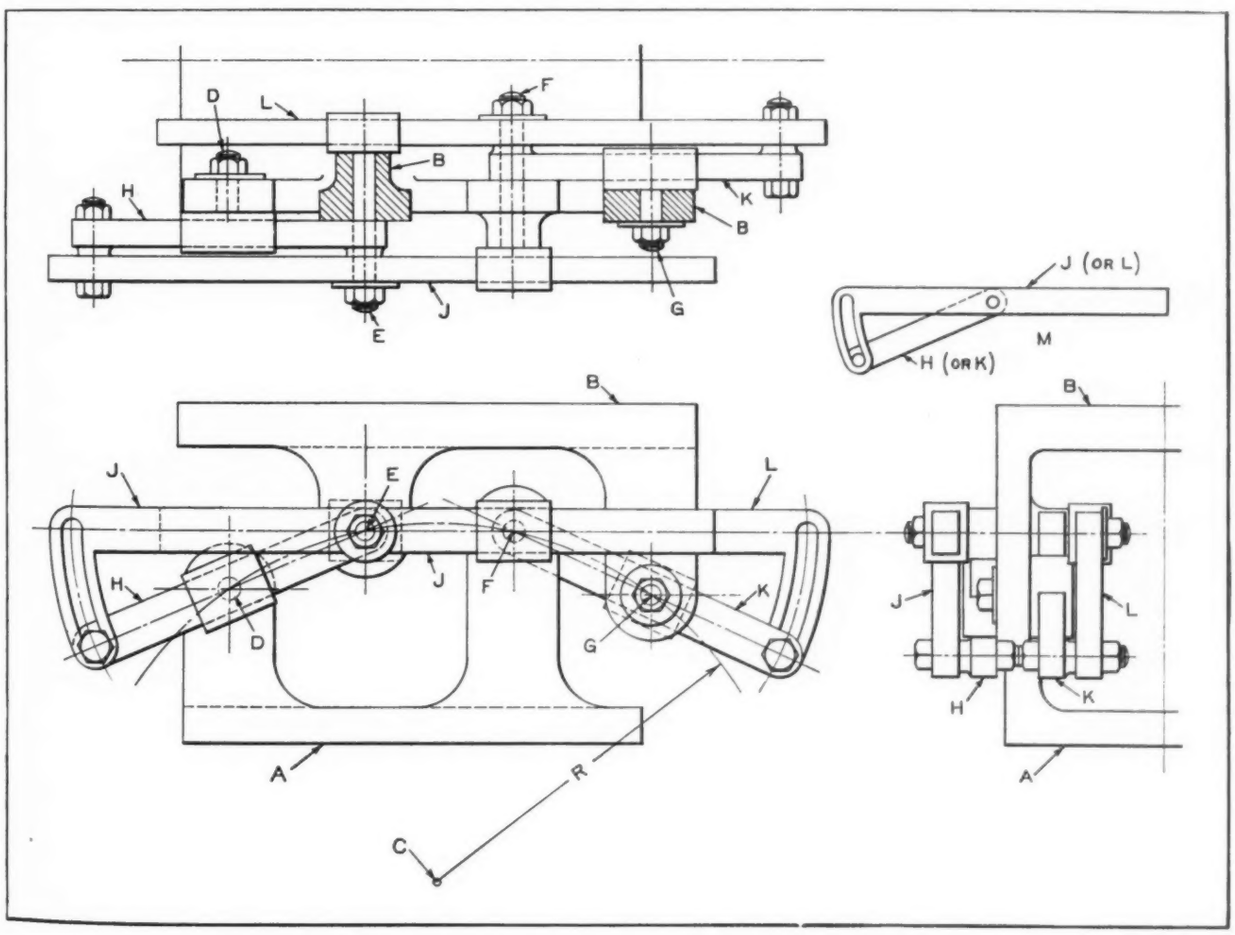
Centerless Oscillating Motion

By A. A. NEFF

Circular motion, such as rotation or oscillation, is usually obtained by means of a guide or constraining member that utilizes as a pivot the center about which the circular motion takes place. This constraining member surrounds the pivot either wholly or partially and causes the moving object to travel in a circular manner about the center. In this case, the center must obviously be accessible.

There are instances, however, where the center does not lie within the workable confines of a given specimen in which true circular motion is desired, and it is necessary for a sliding constraining member to be used that has been specially formed to suit that particular curvature, or one very close to it. Even though such a constraining member does permit some variation in the curvature, the range of differences is comparatively small, because of difficulties in the practical application of the method.

A mechanism that produces circular motion without regard to the center of the curve, that can be adjusted for a wide range of curves, and that produces genuine rotation, though through limited arcs, is shown in the accompanying illustration. This mechanism is adjustable for various radii of curvature, from a curve of ordinary radius to one of infinity; it will produce straight-line motion or reverse the curvature from convex to concave.



Mechanism that Permits Table B to Oscillate about Center C without Requiring Any Restraining Member at the Center of Oscillation

Although the motion is confined to limited arcs, the device produces not merely revolution but rotation; that is, all points in the moving body travel in circular arcs about the same axis or the curve center *C*. The constraining elements are simple straight-line slides that perform their functions according to the law of geometry pertaining to the location of the vertex of an angle inscribed in a circle.

Referring to the illustration, *A* is the stationary base of the device, *B* the oscillating table, on which anything can be mounted for whatever purpose the circular motion may be desired, as for example, machining a curved surface. The particular design represented in the drawing has clarity for its purpose rather than refinement in construction or action, and is therefore somewhat diagrammatic.

For the sake of clarity, the illustration shows the mechanism in that adjustment that places the center of motion *C* within the confines of the illustration. The top and side views show only half of the entire mechanism, the other half being a duplicate. The following description applies only to the half shown.

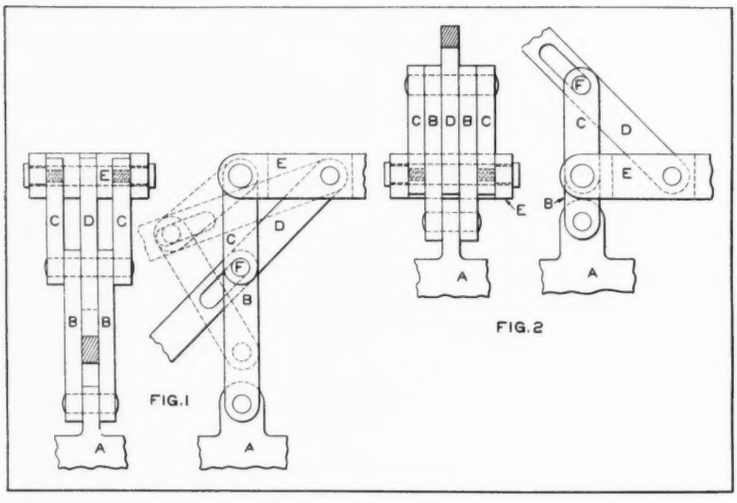
From center *C* a circular arc of radius *R* may be passed through the four pivots *D*, *E*, *F*, and *G*. These four pivots will remain on this circular arc in whatever position the table *B* may be placed. Two of the pivots, *D* and *F*, are stationary on the base *A*, and the other two, *E* and *G*, are on the table *B*. Since the latter two follow the circular path, as will be shown, it follows that the entire table will have a circular rotational movement.

The table *B* is supported by and attached to the base *A* by means of two sliding bar sets consisting of bars *H* and *J* and *K* and *L*, one of which is shown separately at *M*. Each of these sets consists of two bars *H* or *K* and *J* or *L*, the shorter one, such as *H*, being pivoted to the middle of the longer one *J*. By means of the slotted arc, the shorter bar can be locked at any angle with the longer one within the range of the slot. One of these bar sets, *H* and *J*, is pivoted on the table at *E*, and the other, *K* and *L*, is pivoted on the base at *F*.

The bars of these bar sets slide in swivel guides, two of which are located on pivots *E* and *F* in line with but opposite to the pivots mentioned, and two more are located on pivots *G* and *D*. These guides are pivoted, respectively, in the table and base, as shown, and are free to turn, so as to assume the positions required by the bars that slide through them. The two bars *H* and *J* of the set that is pivoted at *E* slide in the guides on pivots *D* and *F*, respectively. The two bars *K* and *L* of the set that is pivoted at *F* slide in the guides on pivots *G* and *E*, respectively.

The action of the mechanism is as follows: The illustration shows the device in the mid-position of its motion. The points *D*, *E*, *F*, and *G*, are equally spaced. Therefore the angles in the two bar sets must be equal. As the table is moved either to the right or left, the vertex *E* of the angle in the bar set *H* and *J* follows along the circular path in accordance with the geometry of the inscribed angle and its subtended arc. Then the triangle *EFG* of the other bar set *K* and *L* is congruent to the triangle *DEF* of the first set, and since *E* and *F* already lie on the circle, it follows that *G* also lies on the circle by the same law of geometry. From the fact that the two points *E* and *G* of the table move in a circular path around the center *C*, it follows that the entire table rotates about this center.

The location of the center *C* and the corresponding radius of curvature depend on the angular adjustment of the bars in the slide bar sets, both of which must be alike—the smaller the acute angle the greater the radius. When the bars are in a straight line, the radius is infinite and the motion is in a straight line. If the angle is changed still further, it becomes negative and the curve of motion is inverted; that is, the curve becomes concave toward the upper side instead of convex. The same concave effect is obtained, however, by inverting the whole device.



Figs. 1 and 2. Lever-and-link Motion which Locks Slide A at Each End of the Vertical Stroke

Double Locking Lever Motion

By L. KASPER

A lever-and-link motion used to operate a slide that must be locked against movement at both ends of its vertical travel is shown diagrammatically in Figs. 1 and 2. The linkage automatically provides the desired locking feature in both positions. The links *B* are connected to the slide *A* at their lower ends and are pivoted at their upper ends to the bracket *E*, attached to a stationary

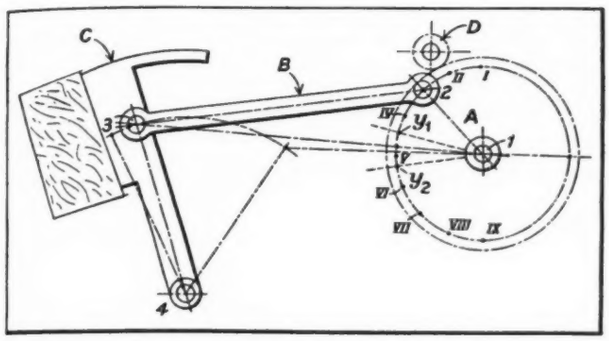


Fig. 1. Mechanism Originally Employed on Straw-baling Press

part of the machine. The hand-lever *D*, pivoted in the bracket *E*, passes between the links *B*, and is slotted to permit the pin *F* to pass through.

In Fig. 1, slide *A* is shown at its lower position. Links *B* and *C* have their centers in the same straight line, thus producing a dead center condition which locks slide *A* against movement in either direction. It will be noted that lever *D* is at an angle of approximately 45 degrees with links *B* and *C*. As the outer end of lever *D* is raised, the angularity of the slot in lever *D* causes pin *F* to be moved outward, so that links *B* and *C* are moved from their locked positions. Continued movement of lever *D* causes pin *F* to slide in its slot, and links *E* and *C* to swivel on their connecting pin, as shown by the dotted lines, so that slide *A* is drawn upward.

Further movement of lever *D* causes links *C* to rotate 180 degrees on their upper pin, and links *B* to enter the spaces between links *C*. At the extreme upper position of slide *A*, as shown in Fig. 2, links *B* and *C*, again being in alignment, cause slide *A* to be locked against further movement. Thus the arrangement of the links is such that movement of slide *A*, when at its upper and lower positions, can be accomplished only through movement of lever *D*.

The full exerted pressure loads the mechanism. The swinging piston is quickly pushed forward and is already on its return stroke when the knot is tied. Therefore the elasticity of the bale stretches the binding cord and hinders the binding mechanism. High friction in the links increases the wear, and the forward and return strokes are performed at an almost identical speed.

In the improved mechanism, shown in Fig. 2, two members *E* and *F* are added, and the number of links is thereby increased from four to seven (as the connecting link between the three members *B*, *E*, and *F* must be calculated as two links). The new mechanism has two dead points; therefore, the toggle action shown in Fig. 2 is extended to about three times that of the older mechanism. The push exerted during the pressing action is taken off the gear and transmitted to the fixed link 5. The speed of the piston is gradually reduced until it is brought to a standstill. It remains in this position until the binding action is completed. The whole drive runs easily and without shock. The wear is consequently reduced to a minimum, and the capacity of the new machine is considerably increased.

Similar mechanisms can be employed in other industries, such as the one shown in Fig. 3, which is used in a press designed for molding plastics. This mechanism is the same as in Fig. 1, except that the swinging motion of the piston is replaced by the reciprocating sliding movement of a ram. Owing to its high capacity, better results are obtained with this press than with the older design having a simple crank mechanism. P. G.

* * *

A special alloy of iron and nickel so hard that it will scratch glass has been patented by research engineers of the International Nickel Co. The chief use for this alloy, which is more than three times as hard as ordinary gray iron, is for machining parts exposed to severe wear and abrasion.

Double Toggle-Lever Mechanisms for Operating Presses

The capacity of a straw-baling press designed as shown in Fig. 1 was considerably improved by redesigning the operating mechanism. The machine has an oscillating pressing piston *C*, actuated by a rod *B* from a rotating crank *A*, which is constructed as a gear wheel and rotated by a small gear *D*. The pressing action takes place when the three links 1, 2, and 3 form practically a straight line, a high pressure then being applied to the straw bale during the interval y_1–y_2 of the crank motion. This interval is so short that the baling action is not quite perfect.

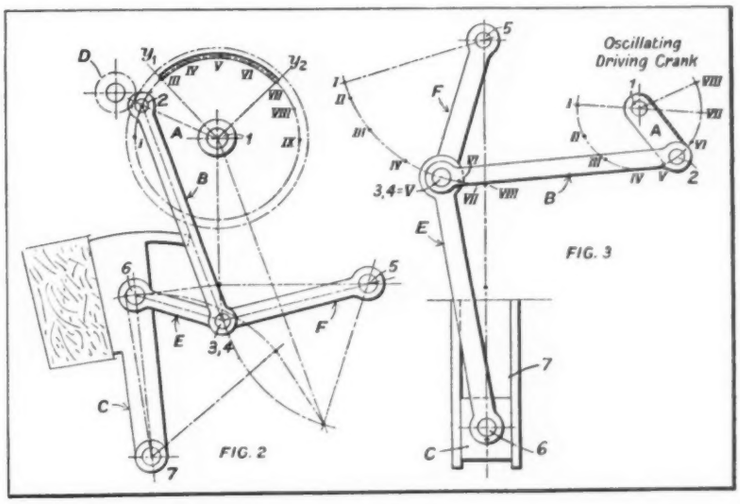


Fig. 2. Double Toggle-lever Mechanism for Straw-baling Press.
Fig. 3. Double Toggle-lever for Plastic Molding Press

Practice in Machining Zinc-Alloy Die-Castings

Directions for Machining Die-Castings, Compiled by the New Jersey Zinc Co. on the Basis of Information Obtained from a Great Number of Plants where Die-Castings are Produced and Machined, and from Makers of the Required Tools and Equipment—Fifth of Six Articles

THE preceding articles in this series, published in the October, November, December, and January numbers of MACHINERY, have dealt with drilling, tapping, reaming, facing, turning, milling, broaching, and shaving operations on zinc-alloy die-castings. The present article describes grinding, polishing, buffing, and tumbling operations.

Grinding and Polishing of Die-Castings

The terms "grinding" and "polishing" are used more or less interchangeably by die-casters, but, in general, "grinding" refers to the removal of fins and parting lines and to similar surface grinding in which a considerable amount of metal is removed by abrasive means, whereas "polishing" refers to the smoothing of surfaces (often including the parting) as a preparation for plating. Polishing is generally done with a finer abrasive than is used for grinding. "Sanding" is a form of grinding or polishing in which an abrasive belt or disk is employed.

In most grinding and polishing, the casting is held by hand, and there are, as a rule, no special precision requirements, as in cylindrical or surface grinding, where the work is rotated on centers or fastened on a faceplate. Such precision grinding is readily done if required, however, provided a type of wheel that will not load excessively is employed or the wheel is dressed with sufficient frequency. Loading occurs with zinc alloys much as with other metals that are relatively soft, compared to steel.

Most grinding is done dry or with a waxed wheel, but in precision grinding, a liquid lubricant may be used. Satisfactory results in the grinding of die-castings are reported with a No. 3736-K Crystolon (silicon-carbide abrasive) vitrified wheel, using a lubricant called "Aqua-Sol," designed to prevent loading with soft metals. Centerless grinding is entirely feasible.

Some grinding is done with 60-grain resinoid-bonded wheels without perforations and lubricated by frequent application of wax to the cutting face of the wheel. For a smoother finish, the same type of wheel, but with 100-grain abrasive, meets the requirements. In one shop, wheels of this kind, 23 inches in diameter with a 3/4-inch face, are used. They are run at 1200 revolutions per min-

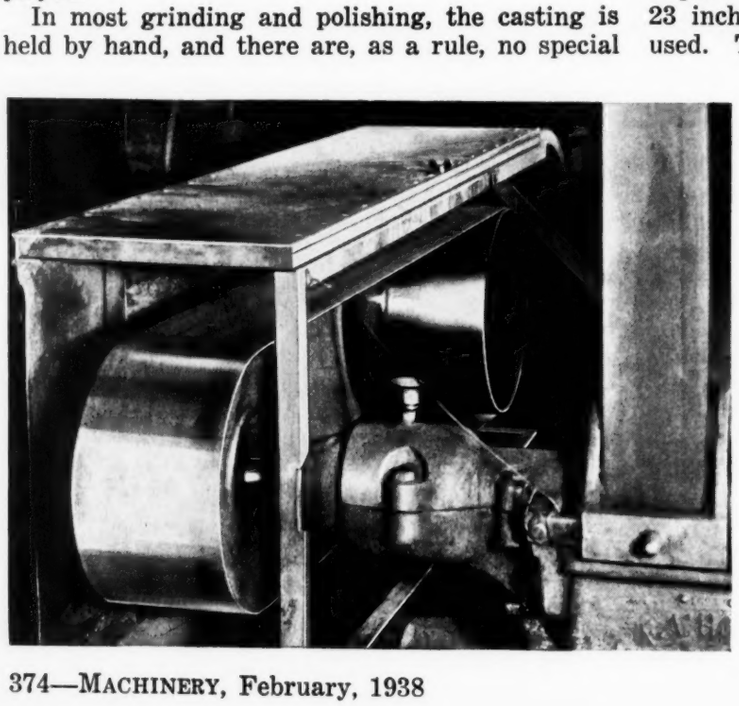


Fig. 18. A Belt Sander in which the Cutting End of the Belt Runs over a Soft Buff so that the Belt can Conform to Irregular Shapes of Castings being Polished, while the Other End of the Belt Runs over a Cast-iron Pulley, so Mounted as to Keep the Belt Tight Automatically

Fig. 19. Parts Finished by the Lupomatic Method of Dry Tumble-burnishing. The Lighter Colored Parts have been through the "Cutting Down" Operation which Produces a Smooth Satin-like Finish, while the Darker Parts have been Given their Final Luster by the Tumble-burnishing Process

ute. Waxing is done with a Hanson-Van Winkle-Munning No. 146 grease stick, about twenty times, on an average, during the life of the wheel or whenever the wheel is redressed. The stick is held against the wheel until all the pores are closed, making a perfectly smooth grinding face.

Another shop reports using any standard type of grinding wheel having a medium grit size and of medium grade or hardness, such as 46 grit, Grade N. The grit size used depends, of course, on the finish required. Polishing wheels are sometimes given a wax treatment under vacuum by the makers. The wax penetrates the entire wheel and has a relatively low melting point, so that it will soften and lubricate the cutting face when only a small amount of heat is generated in the polishing. Such treatment is effective in reducing loading.

The Use of Disk Grinders and Belt Sanders

Much loose abrasive grain is employed for loading disks for the disk-grinding of flat surfaces or edges of castings to remove fins and parting lines. One die-caster reports using 60, 100, 120, 150 and 180 grain for this work. When the finer grains are used, a coarser grinding operation is sometimes required first, especially if much metal is to be removed.

Similar work is done extensively on belt sanders, but the bulk of all grinding is done on felt or canvas wheels, to the periphery of which the abrasive has been glued. Such wheels, as well as some belt sanders, are employed also for polishing castings of irregular shape as a preliminary to plating.

The proportion of castings requiring such polishing (as distinct from buffing) is decreasing, however, because of the greatly improved finish of castings produced today in highly polished dies, usually under high pressure and closely controlled temperature conditions. Many such castings are so smooth that, aside from fin removal, no grinding is needed and only buffing is done before plating. Recently, some quite acceptable automobile hardware has been produced in plated form without even buffing the castings. This has the advantage not only of saving polishing and buffing operations, but of avoiding the chance of uncovering small sub-surface pores, such as sometimes mar a ground and subsequently plated surface.

Polishing Preparatory to Plating

Large or complex castings that require plating, however, often need some polishing. This is most frequently done on felt or canvas wheels to which is glued No. 180 aluminous abrasive or emery for coarse grinding (roughing), and No. 240 grit for fine grinding (finishing), the surface speed of the polishing wheel being from 5000 to 6000 feet per minute.

Wheels of this type, though sufficiently flexible to conform in some degree to a surface of irregular shape, are still quite hard. They also require the expenditure of considerable time in renewing the abrasive. To overcome or reduce these disadvantages, recent experiments have been made with the use of belts of emery cloth or its equivalent, which, instead of being used on a conventional belt sander, are run over a relatively soft buffing wheel at the polishing end, and over a metal pulley of the same width and diameter at the other, with provision for automatic adjustment of the belt tension. (See Fig. 18.) This gives a long grinding surface of whatever width is desired, in combination with a firm but flexible surface similar to that of the buff itself.

This method has worked out quite well in one shop. The belts are found to last for from four to eight hours of continuous polishing, if care is used not to exert an excessive pressure with the sharp edges of the castings, which otherwise might cut the belt. The fact that the belt can conform somewhat to the irregularities of the casting helps to increase production.

Buffing of Die-Castings

Buffing is commonly done on castings to be plated, whether they have been ground previously or not. It is accomplished with muslin or canvas wheels, loose or bias-stitched, using tripoli or other buffing compounds. The wheels may be of any desired width and are commonly run at a surface speed of 5000 to 10,000 feet a minute.

The buffing is usually continued until the piece is free from scratches and such other blemishes as may mar the subsequent plating. A final buffing, sometimes called "coloring," is done occasionally

after buffing and before plating, using a soft dry wheel. It is best to avoid the use of lime compounds in coloring, however, because they sometimes form insoluble precipitates in the chemical cleaning operations which should precede the plating. Compounds containing grease of high melting point should also be avoided, as they may not be removed entirely in hot alkaline cleaning solutions.

Burnishing and Tumbling

Burnishing of zinc-alloy die-castings is not a common operation, but has been practiced on a limited scale for some years, although the methods followed have been kept secret. Recently, however, the Lupomatic Tumbling Machine Co. has developed a commercial system for dry burnishing, using 30-inch maple-lined tumbling barrels and compounds of its own make which are furnished with directions for use. The following particulars are taken from information supplied by that company:

For the initial cutting-down process, a coarse abrasive mixture and hardened cutting-down chips are employed. The second operation makes use of the same chips, but adds a special burnishing compound in place of the abrasive. To produce the final luster or "color," the tumbling is continued, using either coloring chips or a special coloring compound. Several factors, including the initial degree of smoothness of the castings, their size and shape, and the quality of finish required, determine the time needed for each operation, but, in general, small castings require a total of from 18 to 36 hours tumbling, and larger castings, from 23 to 40 hours, for the three operations combined.

As compared with wheel polishing and buffing, this process is claimed not only to be much less expensive, but to provide an equally good finish, as well as to reach into recesses and inside corners that cannot be reached in wheel operations. "Cutting down" is more or less equivalent to grinding and polishing on a wheel, but reaches surfaces not easily reached by a wheel. It is a good preparation for wheel buffing, which may take the place of the final burnishing, if desired.

The process just described has not yet attained extensive commercial use, but is employed by at least one commercial die-caster, and samples treated in this manner (see Fig. 19) indicate that it has sufficient merit to deserve consideration, especially on small castings requiring the class of finish it is capable of giving. It should be remembered, however, that any polished or buffed surface on zinc die-castings is subject to tarnishing unless protected by plating or some other applied finish.

Wet Burnishing of Die-Castings

Wet burnishing with steel balls in a soap solution, much the same as is used on die-castings of aluminum alloys, has also been done on a somewhat limited scale on zinc-alloy die-castings. This results in a moderately high luster. Up to the present time, details of the process have not been made available for publication. Castings thus treated are subject to tarnishing, of course, unless protected by clear lacquer or varnish.

Dry Tumbling and Tumbling in Graphite

Tumbling dry in an abrasive is sometimes employed on small parts as a means of removing burrs or light fins such as sometimes result from machining. This can be done in about twenty minutes with a suitable abrasive, but results in rounding of corners and in some dimensional changes, and thus is not suitable where close dimensions must be held. It is used chiefly for hidden parts not requiring an applied finish.

Tumbling in graphite is an excellent treatment for small hidden parts, such as those used in lock assemblies, especially when the parts are subject in service to relative motion or light rubbing action in contact with mating parts. Such treatment applies a light film of lubricant which is fairly enduring under certain conditions and may aid in avoiding sticking. The treatment should not be used as a substitute for such chemical treatments as that termed "Cronak," which are designed to avoid surface corrosion, especially in the presence of moisture, but may supplement the latter.

* * *

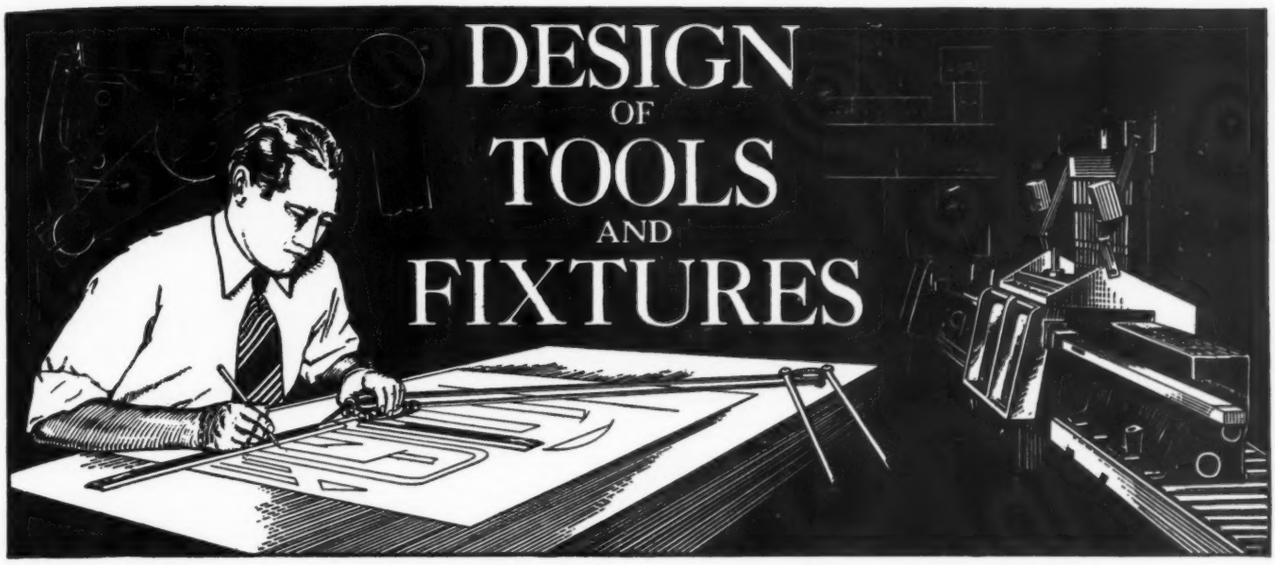
Compressed Gas Manufacturers Celebrate Twenty-Fifth Anniversary

The Compressed Gas Manufacturers' Association, Inc., 11 W. 42nd St., New York City, celebrated the twenty-fifth anniversary of the formation of the Association at a meeting held at the Waldorf-Astoria Hotel, New York, January 17 and 18. For a quarter of a century, the Association has handled the technical problems of the many-sided industries that are concerned with the production and distribution of commercial gases, including acetylene, oxygen, etc. It has taken a leading part in matters of safety in the design of containers and methods of handling and transporting commercial gases under pressure. Franklin R. Fetherston is secretary and treasurer.

* * *

Machine-Building Plants in the United States

The completed Census of Manufactures for 1935 shows that there were in that year 11,778 establishments in the United States engaged in manufacturing machinery. Transportation equipment manufacturers are not included in this group. These machinery manufacturing plants employed in that year, on an average, about 167,000 salaried employes and 790,000 wage-earners. They paid out in salaries approximately $350,000,000, and in wages, $913,000,000. The value of the products manufactured was $3,816,000,000.

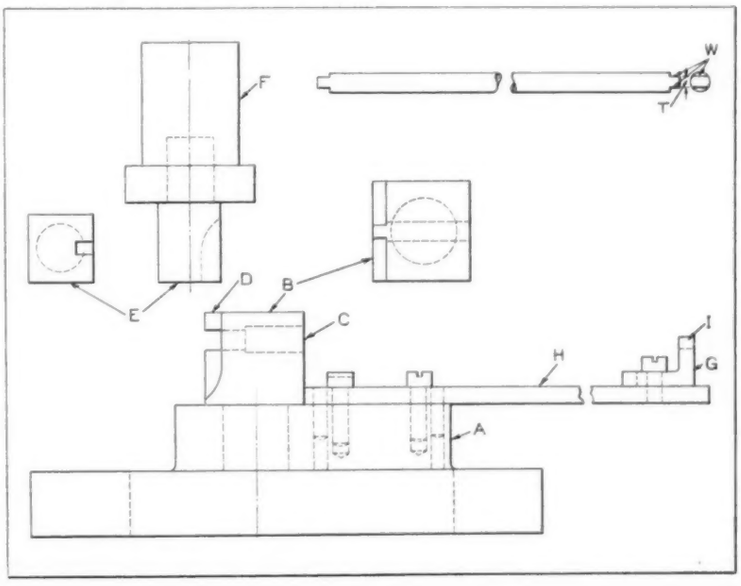


Die for Producing Flats on Ends of Round Steel Rods

By GEORGE WILSON, Marshalltown, Iowa

Round steel rods, 5/16 inch in diameter by 12 inches long, are required to have a flat machined on both sides of each end, as indicated at *W* in the accompanying illustration. The flats are 3/16 inch across, 3/16 inch long, and must have sharp shoulders. They must also be in alignment with each other. At first, these flats were produced on a milling machine, by the use of straddle milling cutters, the work being held in the milling machine vise. The die shown in the illustration for cutting or shaving the flats was built to meet the demand for a faster and more economical production method.

The shank of die *B* is pressed into shoe *A*. The die has a hole passing through it horizontally, which is slightly larger than the rod at the cutting side, and there is a clearance toward the back which permits the rod to be lifted slightly at the outer end so that it will pass over stop *G*. A tongue *D* is machined on die *B* to the same width as width *T* of the work. Punch *E*, which is mounted in the holder *F*, has a groove machined in its vertical face, as shown, that is a close fit on tongue *D*.



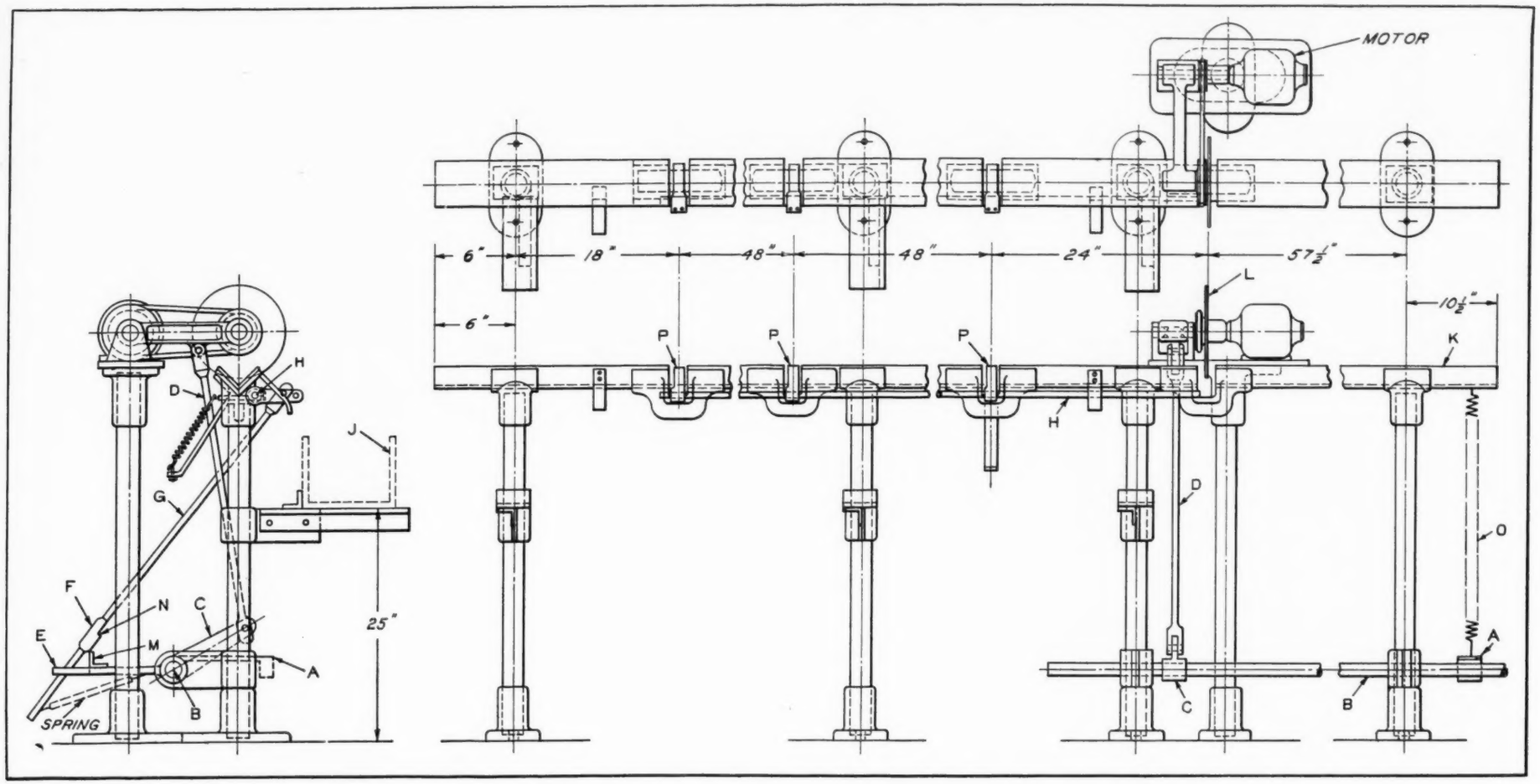
Die for Shearing Flats on Ends of Round Rods

A rod, cut to length, is inserted in die *B* and its outer end located against stop *G*, which is set at its outer position. After the entire lot of rods has been sheared on one end, stop *G* is moved to its inner position, the pieces being held in alignment by the previously machined tongue which fits into the slot *I*. The flats on the opposite end of the rods are then cut to size.

Foot-Operated Cutting-Off Saw Equipped with Ejector Unit

The equipment shown diagrammatically in the illustration (see page 378) is designed to permit long lengths of tubing to be cut off and delivered to the work retaining box *J* by simply stepping on the foot-pedal *A*. The tubing is fed along the V-shaped trough *K* until it is in the proper position to be cut off by the high-speed motor-driven swing saw *L*.

The downward motion of foot-pedal *A* rotates the shaft *B* on which a lever *C* is mounted. Lever *C* is connected with the swing saw arm by rod *D*. As the saw moves downward,



Cutting-off Saw Equipped for Operation by Foot-pedal, and an Arrangement for Automatically Delivering Cut-off Pieces to Work-box

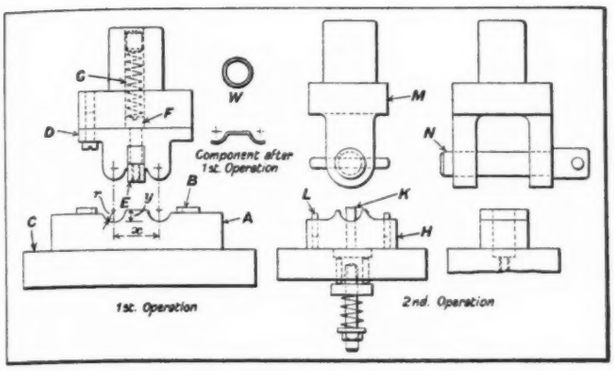
the tube is cut off. On shaft *B* is also mounted a lever *E*, which is notched out at the end and has a small angle-iron *M* attached to it, as shown.

As the foot-pedal moves down, the notched end of lever *E* moves up until the notch engages the shoulder *N* on block *F* on connecting-rod *G*. A tension spring *O*, connected to the foot-pedal, returns the foot-pedal to the starting position. On the return stroke of the foot-pedal, connecting-rod *G* actuates shaft *H*, which carries a number of fingers *P* for ejecting the cut-off tube from the angle-iron trough into the work retaining box *J*.

Before the completion of the return stroke, angle-iron *M* disengages lever *E* from connecting-rod *G*, allowing the ejector fingers to return to their original position. T. M.

Dies for Forming Circular Collars from Flat Stock

The first- and second-operation dies here illustrated are designed for the production of circular collars, such as shown at *W*, from medium hard flat stock, 1/2 inch wide and about 1/32 inch thick. These dies are made in various sizes for forming collars ranging from



First- and Second-operation Tools for Bending Strip Material into Circular Collars

7/16 inch to 3 inches in diameter. When medium hard metal is bent or formed, there is a certain amount of "spring back," and the allowance that must be made in a bending or forming die to compensate for this change in the shape of the formed part upon its removal from the die can be determined only by trial. For this reason, the two dies shown have been so designed that their forming surfaces can be readily reshaped.

The first bending tool comprises a die *A* with locating pieces *B*, the die being secured to the bolster *C*. The radius *r* is that of the circle required, the dimension *y* being found by trial, while the center distance *x* is approximately twice the diameter of the circle required.

The punch *D* corresponds to the form of the die, the spring pad *E* in the center being retained by a shouldered screw *F*. The spring *G* provides the blank-holding pressure.

The second-operation tool comprises a die *H*, with spring ejector *K* and locating pins *L*. The punch *M* is forked to accommodate the sliding pin *N*, around which the finished collar is formed. The pin *N* is withdrawn to allow the collar to be removed. The collar can be turned around on the pin *N* to different positions after the first stroke of the press, and the stroke repeated, in order to smooth out any irregularities in the formed surface and bring the edges of the formed shell together.

B. M.

Form-Dressing Fixture for Grinding Wheels

By HECTOR J. CHAMBERLAND, Springfield, Mass.

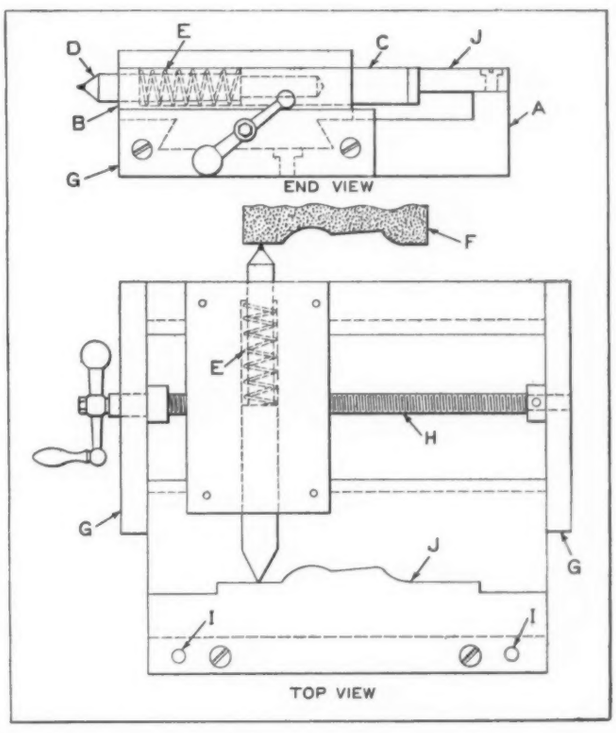
A fixture for forming grinding wheels to a given radius was described in September MACHINERY, page 29. The fixture here illustrated is designed for dressing wheels to intricate forms for form-grinding cylindrical work.

When but one or two pieces are to be form-ground, it is customary to resort to the cut-and-try method, using a templet, if one is available. In cases where a dozen or more identical parts must be form-ground, considerable time is spent in an effort to keep the wheel face dressed to the required shape. Uniformity of the work is usually way below par when such methods are employed. A fixture such as shown in the illustration, permits work of this kind to be handled in a practical and satisfactory manner. If the fixture is to be used frequently or for production work, the principal parts should be made of wear resisting materials.

The fixture shown has a traverse movement of 2 3/4 inches and will form a profile or outline having a maximum drop of 3/4 inch. This fixture must, of course, be attached to a cast-iron base, machined to the correct height and radial position.

The base *A* and slide *B* are of dovetail construction, slide *B* being made in two parts, with a top plate to facilitate machining the slot for the plunger, which consists of the two parts *C* and *D*. The plunger is made in two parts for convenience in resetting the diamond. The slot for part *C* is 1/2 inch square and extends to within 1/4 inch of the front edge of slide *B*. This slot is machined with an end-mill and the corners are shaped by filing. The solid section is bored for the cylindrical part *D* of the plunger, and both parts *C* and *D* are close fits in the slide.

Plates *G* are fastened to the ends of base *A* and are bored to receive the feed-screw *H* which operates slide *B*. Pins *I* locate the master forming block *J*, which is secured by two screws. The back end of plunger *C* is of angular or wedge shape, being machined to practically a sharp edge as shown. It is important that this plunger have a sharp edge if a sharp corner or small radius is to be duplicated.



Fixture with Profile Plate for Dressing Wheels for Form-grinding

The truing diamond must be of the elongated variety and must be kept sharp; otherwise trouble will be experienced in duplicating many forms. The coil spring *E* keeps plunger *C* pressed firmly against the formed surface of the master forming block *J*. As the fixture is operated independently of the traversing table of the grinder, it is essential that it be accurately aligned and fastened in position parallel with the face of the grinder. Also all adjustments between centers and all straightening or aligning must be made previous to dressing the wheel face, because any change afterward will introduce inaccuracies.

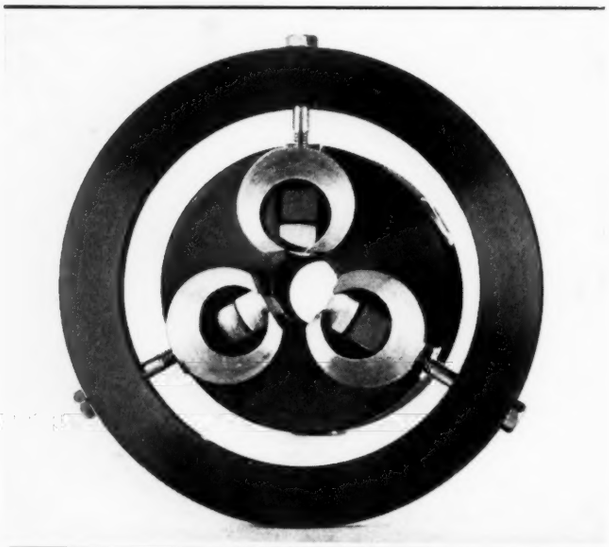
Fixture for Regrinding Chuck Jaws

By VICTOR ARKIN, Los Angeles, Calif.

A fixture that has been used to advantage in regrinding the inner ends of universal chuck jaws is shown in the accompanying illustration. Although shown applied to a three-jaw chuck, the fixture is supplied with an extra chuck jaw clamp and suitably spaced holes in the ring section for regrinding the jaws of four-jaw chucks. After a universal chuck has been used for some time, the jaws become bellmouthed, with the result that they will not grip a rod for the full length of the jaws or hold it true.

The purpose of the fixture is to hold the jaws back or under an outward tension, the same as when they are gripping a piece of work, while the inner work-gripping ends are being ground true with an internal grinder. The internal grinder can be clamped in the toolpost of the lathe for this operation.

After regrinding the jaws of all the universal chucks on the larger lathes in the shop where the writer is employed, the spindle and the small universal chuck of the bench lathe were removed, and the back end of the spindle placed in the chuck of one of the larger lathes with the front bearing in the steadyrest, in order to regrind the chuck jaws. This was done because the bench lathe was too small to hold the internal grinder. The illustration shows the bench lathe chuck with the regrinding fixture in place, a job for which the outer ring of the fixture appears to be unnecessarily large in comparison with the chuck.



Fixture Applied to Small Bench Lathe Chuck for Regrinding Inner Ends of Chuck Jaws

* * *

Results of Laboratory Tests on Motor Drives

Some interesting tests on the comparative cost of group and individual motor drives have been made by the Graton & Knight Co., Worcester, Mass., in the Mobile Laboratory equipped by this company for testing belt drives and demonstrating group and individual motor drives. This Mobile Laboratory was briefly described in December, 1937, MACHINERY, page 288-A.

In a detailed study of group drive and individual motor drives as applied to the four generators in the laboratory, data was recorded of the cost of installing and operating the two systems in a typical plant under a similar operating schedule. The figures do not include the cost of meters or instruments used for power measurements or the equipment installed for demonstration purposes.

The total installation cost for the group drive was $399.47, and for the individual motor drive, $646.27, showing a saving in favor of the group drive of 38.2 per cent.

The annual fixed charges, including depreciation, interest, taxes, and insurance, were $59.92 for the group drive and $96.94 for the individual drive, while the annual power cost was $124 for the group drive, as compared with $134 for the individual drive. This gives a total operating cost of $183.92 for the group drive and $230.94 for the individual drive, showing a saving of slightly over 20 per cent in favor of the group drive.

The laboratory is so arranged that these comparative tests can be run off and demonstrations made at any time to groups of engineers and mechanical executives at the plants that the Mobile Laboratory visits for demonstrations. The pulling power of different types of belts can also be readily demonstrated.

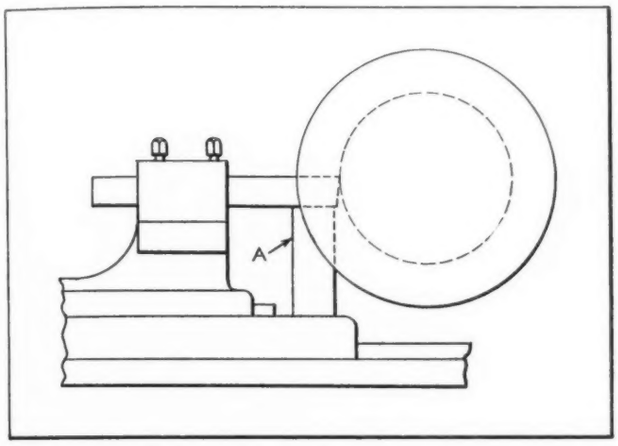
* * *

Exhibitions During 1938

The third annual edition of the list of industrial, trade, commercial, and professional shows and exhibitions scheduled for 1938 was recently published by the Exhibitors Advisory Council, Inc., 330 W. 42nd St., New York City. This list covers very completely exhibitions and shows to be held in every branch of industry and business.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Method of Supporting Lathe Parting Tool

Supporting Parting Tool to Eliminate Chatter

A method that has been used successfully to eliminate tool chatter when cutting off heavy forgings with a parting tool is shown in the accompanying illustration. It consists simply of placing a support *A* under the tool in the position shown.

FRANK RATTEK

Advantages of Hanging Belt-Shifting Poles

There are still many plants in which belts are shifted by the use of a belt-pole, as was done forty or fifty years ago. About forty years ago the writer saw installed at each belt-driven machine in one of the then really large tool-rooms of this country, what were termed hanging belt-poles. The poles were much the same as those used by machinists for a hundred years or more. They were somewhat shorter and lighter than the usual type and had a metal "finger" near the upper end.

Each machine driven from an overhead countershaft was provided with one of these hanging poles, suspended by a chain about 18 inches in length. The upper end of the pole, when not in use, hung slightly below the center of the cone pulley, its lower end within easy reach of the operator. These shifters were used successfully during the period that the writer remained at the plant.

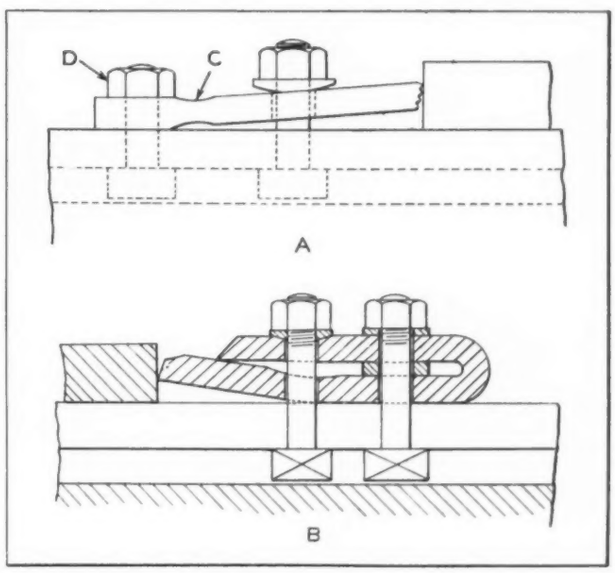
No more was seen or heard of the hanging belt-pole by the writer until about three years ago, when an acquaintance had one installed for shifting the up-and-down belt of a 16-inch lathe. All the lathe men who used this belt-pole pronounced it a great improvement over previous equipment used for belt shifting. The men who work at night like it because they do not have to hunt in the dark or poorly lighted corners for a belt-shifting pole. With the hanging belt-shifting pole the belt shifting is done with a simple twist of the wrist. One scarcely needs to see its upper end. Not only is the hanging pole always at hand, but it saves time and effort as well.

Wilkinsburg, Pa. WILLIAM S. ROWELL

Low Hold-Down Clamps

A clamp for holding thin pieces which leaves the end or side clear for the over-run of the tool or wheel is shown at *A* in the accompanying illustration. The clamping bar is thinned at *C* to provide the necessary springiness for the pull-down action after the nut *D* has been tightened.

The clamping bar at *B* is bent back upon itself, and a washer interposed to sustain the tightening pressure of the binding bolt. The other bolt, when tightened, exerts sufficient pressure to spring the clamp nose down and hold the work securely in place. Both of the clamps here illustrated provide positive resistance against endwise or sidewise movement of the work. F. H.



Hold-down Clamps for Thin Work

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Hardness and Machineability

A. Z.—What is the maximum hardness of a machineable steel? For example, is it possible to determine whether a steel can be turned, milled, or drilled when either the Brinell or Rockwell hardness is known?

A.—The answers to these questions depend, first, upon what is meant by machineability. If the term implies the cutting or machining of some material for a reasonable or economical length of time before tool sharpening or replacement is necessary, then this time interval becomes an important factor. This interval, however, depends not only upon the hardness of the material or its resistance to cutting, but also upon such factors as the cutting speed, the kind and quality of tool used, the kind and quantity of coolant, if any, and the rigidity of the tool support.

The maximum hardness of a machineable steel or other material, because of these variable factors, extends over a wide range, which has been increased greatly since the introduction of cemented-carbide tools. The maximum hardness of a machineable material under one set of conditions might range, for example, from 150 to 200 Brinell, and under other conditions, from 400 to 500 Brinell, or even higher.

Relation between Hardness and Cutting Speed—In cutting steel, the allowable cutting speed for a given tool life between grindings, as a general rule, is inversely proportional to the hardness of the steel. To illustrate, tests in turning an alloy steel with a high-speed steel tool showed a cutting speed of 70 feet per minute when the hardness of the steel was 180 Brinell; the cutting speed had to be reduced to about 35 feet per minute when the hardness was increased to 360 Brinell, the life between tool grindings for these tests being twenty minutes in each case. The machineability of other steels of the same hardness might vary. For example, the tests just referred to showed more or less variation in the cutting speeds for steels having the same hardness but different compositions or properties. Thus, while there is a constant relationship between the hardness of a steel and its tensile strength, there is not a constant relationship between hardness and machineability as applied to different steels.

In one test, a high-speed steel turning tool lasted twenty minutes between successive grindings when cutting chromium-vanadium steel of 300 Brinell at 30 feet per minute, whereas a 3 1/2 per cent nickel steel of the same hardness permitted a cutting speed of about 45 feet per minute for a tool life of twenty minutes. To cite another example, the cutting speed during a twenty-minute interval between grinds was 170 feet per minute for nickel-chromium steel of 280 Brinell, and 210 feet per minute for chromium-vanadium steel of the same hardness.

Relation between Hardness and Machineability of Cast Iron—Although the allowable cutting speed of a steel is about in inverse proportion to the hardness, the machineability of cast iron may not be changed by increasing the hardness, and may even be improved. For example, it was found more difficult to machine a plain cast iron of about 170 Brinell than a nickel-chromium cast iron of 240 Brinell. In another case, plain iron of 160 Brinell was more difficult to machine than a cast iron of about 200 Brinell containing less silicon and 1.25 per cent nickel. As the examples show, there is no fixed relationship between the hardness and machineability of plain and alloy cast irons.

Relation between Tensile Strength and Hardness—Since there is a constant relationship between the ultimate tensile strength of steel and its hardness, the latter may be determined if the former is known, or vice versa. The following simple rules show the approximate relationship between tensile strength and hardness, as determined by both the Brinell and Rockwell tests.

Brinell hardness = tensile strength $\times$ 0.002 approximately

Rockwell hardness (C scale) = tensile strength $\times$ 0.0002 approximately

Example—Tensile strength of S A E nickel-chromium steel No. 3230 when hardened and drawn to 1100 degrees F. is 120,000 pounds per square inch. Determine the Brinell and the Rockwell hardness numbers.

Brinell = 120,000 $\times$ 0.002 = 240; Rockwell = 120,000 $\times$ 0.0002 = C24

Example—The hardness of a molybdenum steel No. 4340 is 330 Brinell. Determine its approximate tensile strength.

$$\text{Tensile strength} = \frac{330}{0.002} = 165{,}000 \text{ pounds per square inch}$$

* * *

It is only thirty years ago that a Toledo eye specialist told us that the air pressure against the eyeballs of automobile drivers and passengers, unless the eyes were protected by goggles, would prove very dangerous. However, he also volunteered the consoling prediction that in the course of time Nature would come to the rescue of the automobilist by developing "tougher and harder eyeball muscles than had been known in the past."

The Welding of Stainless Steel

Directions for Making Successful Fusion Welds in Stainless Steel, Based upon Information Obtained from the United States Steel Corporation Subsidiaries*—First of Two Installments

WHILE there are three groups of stainless steel—the austenitic, the ferritic, and the martensitic groups—the austenitic steels are the most important, both in point of usefulness and as regards tonnage produced. They combine high tensile strength and high ductility with toughness, and possess the highest corrosion resistance. This group includes the well-known 18-8 stainless steels.

The present article will deal with the welding of austenitic stainless steels. The welding characteristics of these steels are dependent upon the physical properties, which differ considerably from those of mild steel in the following respects:

1. Greatly reduced thermal and electrical conductivity. The thermal conductivity is about 40 to 50 per cent less; and the electrical resistance about six times greater, in the annealed state, and twelve times greater, in the extremely cold-worked condition, than that of mild steel.
2. Thermal expansion about 50 per cent greater than that of mild steel.
3. Melting point slightly lower than that of mild steel.

The austenitic steels can be welded by most of the methods used for mild steel, but cannot, by any present known method, be forge- or hammer-welded.

Precautions to be Observed in Welding Stainless Steel

In welding stainless steels, the most important consideration to be kept in mind is that the closer the character of the deposited metal approximates that of the material to be welded, the better will be the corrosion resistance of the welded joint. The following precautions should be noted:

1. Any carburization, or increase in carbon, must be carefully avoided, unless a harder and better wear resisting material is actually desired, in which case there will be some sacrifice in corrosion resistance.
2. All inclusions of foreign matter, such as chrome oxides, slag, or foreign metal, must be carefully guarded against.
3. In repair work, it is extremely important to clean thoroughly the surface of the metal before beginning to weld. All products of corrosion must be completely removed, so that clean solid metal is exposed. In repairing cracks, it is better to chip out completely, so that no oxide or scale will remain. Unless these precautions are observed, repair jobs will not be satisfactory.

While sound, ductile welds can be readily made by either metal-arc or flame methods, the arc weld is preferable, because it is more rapid and there is less diffusion of heat into the surrounding metal. Arc welding thus reduces buckling or warping, holds carbide precipitation to a minimum, and avoids carbon pick-up. Light gages, however, such as USS Nos. 18 and 20 (0.0500 to 0.0375 inch), and lighter, are generally better welded with the gas torch, since more accurate control of temperature is possible.

In either arc or gas welding, it is desirable to use electrodes, or filler rods, with an alloy content slightly higher than that of the parent metal to be welded. Dilution and oxidation of the weld metal cannot always be avoided. At junctions of stainless and carbon steel, and with beads of stainless on ordinary steel, welds should always be made with higher alloy electrodes or filler rods in order to maintain a proper alloy content in the weld metal.

The edges of all sheets and plates to be welded should be thoroughly clean and free from grease or oil which might result in carbon pick-up, as well as from scale or oxide, to avoid such inclusions in the finished weld.

Holding Devices for Sheets to be Welded

With light gages, there is the difficulty of the high expansion coefficient and low thermal conductivity of stainless steels, which, unless the sheets are suitably held, will cause warping and buckling and render the finished job unsightly.

If there is much welding of light gages, permanent jigs and fixtures should be employed. These should be equipped with bars and screw clamps to hold the sheets firmly in position, while screw motion may be provided for the clamps to line up and adjust distances between edges, etc. With proper holding devices, the strain is confined to a relatively small area of the sheet and expansion takes place almost wholly in the soft plastic weld metal. The low "locked up" stress that may remain is usually of no consequence. If buckling occurs, it can be removed by hammering or peening the weld itself.

*The present article on the fusion welding of austenitic stainless steels is abstracted from the manuscript of a new book on the fabrication of stainless steels, just published by the United States Steel Corporation Subsidiaries, 434 Fifth Ave., Pittsburgh, Pa. The complete book can be obtained by application to the Corporation at the address given.

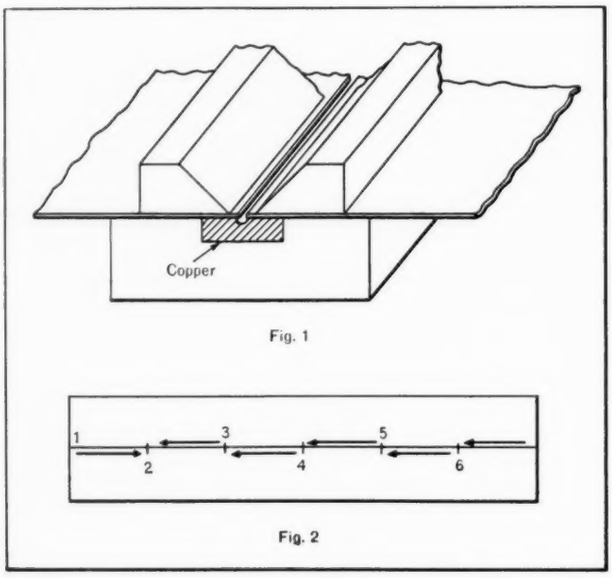


Fig. 1. Method of Holding Sheets to be Welded.
Fig. 2. Diagram Illustrating the "Back Step" Method of Welding

This expands the weld metal and relieves the contraction that causes the buckling.

A suitable arrangement, Fig. 1, will consist of a heavy base in which is inserted a copper chill bar to facilitate heat removal. Pressure is applied by two long bars beveled at an angle of about 45 degrees, facing each other, the bars being about 1 inch apart at the bottom. For convenience, the copper chill bar may be about 3/8 or 1/2 inch by 1 1/2 inches, and have a small groove milled out along the center of one side. This is placed centrally with respect to the edges of the clamping bars. The sheets are then firmly clamped in this fixture with the polished side down, in the case of polished sheets, and the edges lined up over the groove.

The weld is then made from the back, or unpolished side, allowing the weld metal to fill the groove. This procedure gives better penetration, and also, the groove acts as a mold, holding the weld metal in proper shape to facilitate subsequent grinding, or merely giving proper reinforcing. For circular or curved welded joints, a modified device embodying the same principles should be used.

"Tacking" for the Welding of Long Seams

When long seams are to be welded and cannot conveniently be clamped or "jigged," the seam should be "tacked" at short intervals by small welds. This will be described in greater detail in what follows:

On all heavy work, the "back step" method is preferred. This avoids excess heating at any one location and tends to reduce buckling and distortion. It consists in welding a short section, then starting a distance back of the point first welded and welding up to it, then back of the second point and welding to it, etc. That is, beginning at 3 and welding to 2, then 4 to 3, 5 to 4, etc., as shown in Fig. 2. Some difficulty may be experienced in finishing a full bead at the edge, as in welding from 2 to 1. In such cases, it is better to weld from 1 to 2. Similarly, in cases where the section changes, as at the junction of another plate, it will be better to weld to this junction than from it.

The length of the section welded at one time can be half an electrode consumption, as from tack to tack, or a third of the length of a short seam. In this way, concentration of heat at one place is avoided, and less distortion will result.

In welding light sheets, the "back step" method is not necessary, and the weld can be made continuously along the seam from one end to the other. If firmly clamped and tacked, there should be little difficulty from distortion.

Detailed Directions for Metal-Arc Welding

In welding with the metal arc, direct current is used in preference to alternating; and it is generally advantageous to use reversed polarity; that is, the electrode positive and the work negative. Some unusual conditions have been encountered with heavy sections where straight polarity gives better fusion and penetration, but, due to the poor heat conductivity of stainless steels, sufficient penetration is usually obtained with reversed polarity.

The diameter of the electrode should be approximately equal to, or slightly less than, the thickness of the metal to be joined, but in no case should electrodes larger than 3/16 inch be used. Since the electrical resistance of stainless steels is much greater than that of mild steel, short electrodes are the rule. Moreover, long slender electrodes vibrate excessively and make maintenance of a steady arc difficult.

In metal-arc welding, coated electrodes are used, in order to deposit a solid, non-porous weld metal. Electrode coatings are made of materials that will steady the arc, protect the stream of molten metal from the atmosphere, and at the same time, form a fusible slag that will float on and protect the molten metal against oxidation. This slag should be easily removable and should, in greater part, flake away during solidification.

The chemical analysis of the deposited weld metal may differ slightly from that of the electrode. Loss of chromium may be estimated at 1 to 1.5 per cent, and may be disregarded with the higher chromium compositions. Nickel, molybdenum, copper, and tungsten are carried over by the arc without change, as are manganese and silicon, in normal percentages.

Elements that are readily oxidizable will show high losses, approximately 70 to 80 per cent for titanium, and 20 to 30 per cent for columbium. Some slight changes in composition may occur from absorption of manganese, or silicon, in the electrode coating, elements that are used for arc stabilizing and deoxidation of weld metal.

In setting up for welding, light gage sheets, such as No. 18 gage and lighter, are clamped firmly to

prevent buckling and butted tightly together without opening. All seams should be accurately aligned at the start, and it is advisable to "tack" weld at short intervals, in addition to using clamping devices. "Tacks" should be small—and may be as close together as 3/4 inch. If there is excessive slag or oxide on "tacks," it should be removed with a wire brush rather than by hammering, which would tend to expand and separate the edges of the sheets.

Heavier gage sheets, No. 16 to about No. 7, are set up for welding with an opening equal to about one-half the gage thickness. These should also be firmly clamped and may be "tacked." Beveling, or scarfing, is not customary with No. 12 gage and lighter. Heavier gages, and all plates, should be scarfed with a 30-degree angle on each edge, so that when placed together for welding, the scarfed edges form a 60-degree vee. Scarfing should extend to within about 1/16 inch of the bottom.

Actual Welding Procedure

Thicknesses up to about 1/4 inch can usually be welded with one bead, but when both surfaces are to be polished after welding, it is sometimes advisable to weld from both sides, even with gages as light as No. 12, as smoother beads result and polishing costs will be less.

For plates heavier than 1/4 inch, two or more beads will always be required. Edges should be scarfed to within about 3/32 inch of the bottom and set up with a separation of about 1/8 inch. This applies also to plates from 1/2 to 3/4 inch thick. Such heavy plates will always require multiple beads. Very heavy plates, 3/4 to 1 inch, are scarfed from both sides with either V- or U-shaped grooves. Scarfing of edges should not be haphazard, but done carefully and uniformly; otherwise, accurate time and cost schedules will be impossible and satisfactory welds cannot be made.

When multiple beads are necessary, it is best to lay down a succession of light beads, rather than one or two heavy beads in the attempt to save time. Too large a pool of molten metal will shrink excessively in cooling and is likely to show shrinkage cracks when cold. It is also advisable to peen the first layers of metal with a blunt tool to relieve any stresses that might result from contraction of the molten metal. With successive beads, all slag, etc., must be thoroughly cleaned from each layer before depositing the next. The same applies when striking an arc in continuing a weld. Slag is best removed by hammering with a blunt tool, followed by brushing with a stiff brush. Carbon steel wire brushes should be avoided, because of possible contamination of the stainless steel surface, which might cause discoloration.

The electrode should always be pointed into the weld and "figure eight" or excessive side weaving motion avoided, such as may be used in welding mild steel. A slight weaving motion and steady forward travel with the electrode sloped back about 60 degrees will generally give best results.

Amperage and Voltage Required

The characteristics of the current produced by the generator will establish the length of the arc that can be maintained, and for welding stainless steels, the arc should always be as short as possible. Correct voltage is indicated if a slight withdrawal of the electrode breaks the arc. While definite instructions to fit all cases cannot be given, the following table will serve as a guide in commencing operations. Some experimentation and adjustment will usually determine correct welding conditions.

Metal Gage Number	Electrode Diameter, Inches	Amperage	Voltage, Open Circuit
18 and lighter	5/64	25– 50	30–35
18–16	3/32	30– 90	35–40
16–10	3/32–1/8	50–100	40–45
10–3/16 inch	1/8–5/32	80–125	45–50
1/4 inch and heavier	3/16	100–175	55–60

Voltage taken across the arc while welding will run 20 to 25 volts; 35 volts is the maximum that can be expected to weld properly. For chemical plant equipment, where corrosion is severe, experience has shown that multiple beads laid down with small electrodes—5/32 inch with about 100 to 125 amperes—will give best results.

Size of Electrodes Recommended

The use of electrodes larger than 3/16 inch is inadvisable. Too large an electrode creates a large pool of molten metal, which is likely to show shrinkage cracks on cooling. Such cracks may also be caused by too long exposure of the weld metal to the arc stream, as might result from trying to make one pass do the work of two, or from weaving, or puddling, all of which must be strictly avoided.

Too long an arc tends to produce surface pinholes. Larger blow-holes at the surface or in the weld metal are caused by faulty coating or coating of incorrect composition. Increasing the size of the electrode, together with higher current, increases the penetration. Sputtering of the arc is usually dependent on the nature of the coating. Sputtering sometimes causes small drops of molten metal to be deposited on neighboring surfaces, and if these are polished, damage may result. This can be prevented by applying a coating of ordinary whitewash or asbestos paper to each side of the seam.

For vertical or overhead welding, small size electrodes should be used—not exceeding 1/8 inch in diameter, at the current ranges given in the preceding table.

In the concluding installment of this article, to be published in March MACHINERY, acetylene and atomic hydrogen welding of stainless steel will be dealt with, and the important subject of annealing austenitic stainless steels after welding to relieve strains set up through uneven expansion and contraction will be covered.

Die Design and Construction

A Treatise on the Principles Embodied in the Design of Different Types of Sheet-Metal Blanking, Forming, and Drawing Dies—First of a Series of Articles

By CHARLES R. CORY*

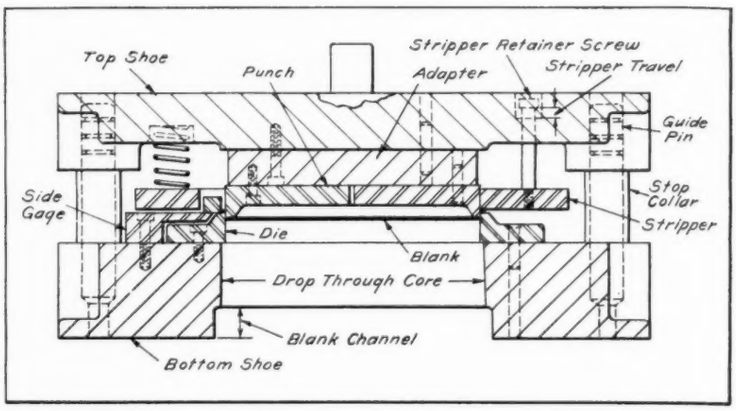


Fig. 1. Typical Design of Drop-through Blanking Die

THE simplest of all sheet-metal working dies, obviously, are blanking dies. There are two types of blanking dies—the drop-through type, where the punching member is above and the die member below, so that the blanks punched drop through the die; and the return-blank type, where the punching member is below and the die member above, so that the blank cut out is forced upward, requiring a knock-out for removing it from the die.

A typical drop-through blanking die is shown in Fig. 1. In this type of die, the punch is mounted on the upper or punch shoe, the blank being sheared out of the sheet-metal stock as the punch moves downward through the stock into the die opening. While the entire assembly is known as a die, that part into which the punch enters in shearing the stock is also generally called the die. This die is mounted on the bottom or die shoe. The blank drops through the die and die-shoe and either falls through a cored hole in the bolster plate or piles up on the top of the plate. In the latter case, the blanks must be pushed out by the press operator at intervals from underneath the die-shoe through a blank channel.

On the up stroke of the press, the stock strip must be stripped off the punch. The stripping is accomplished by a spring-operated plate which holds the stock strip against the die until the punch has traveled up far enough to clear it.

The stock may be fed through the die after each stroke either manually or by means of an automatic feeding device, the position of the stock being determined by gages. This briefly describes the elements of the simplest type of blanking die.

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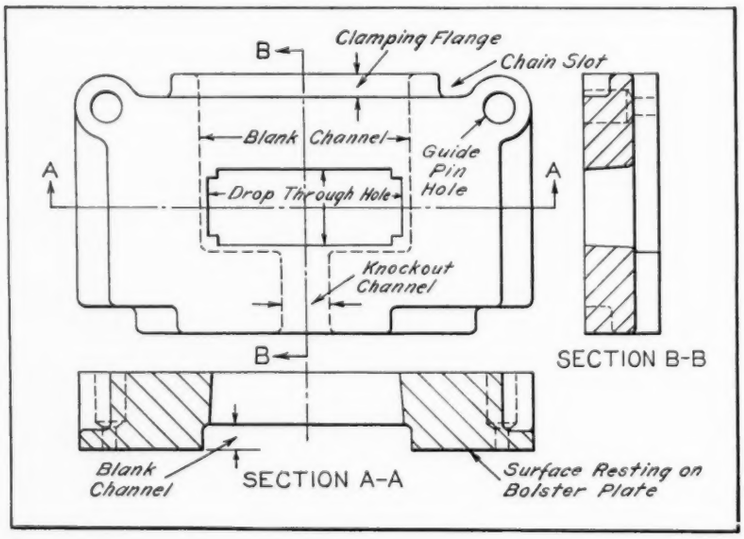


Fig. 2. Typical Design of a Die-shoe for a Drop-through Blanking Die

Construction of the Die-Shoe

The die-shoe, a detailed view of which is shown in Fig. 2, is usually made of cast iron, although boiler plate or machine steel is sometimes used. A clamping flange is provided around the outside of the die-shoe so that it can be fastened easily to the bolster plate of the press. If the die is heavy enough to require a crane to lift it, the die-shoe should be provided with chain slots. The die proper and the stock gages are attached to the machined top surface of the shoe. The latter is provided with two or more bosses for the drilled and reamed holes for the guide pins that keep the punch- and die-shoes in proper location with respect to each other.

The die-shoe must also have a cored hole somewhat larger in size than the blank, for the blank to drop through. If the outline of the blank is intricate, this drop-through hole may be machined rather than cored. It should not be very much larger than the blank, to avoid

overhang of the cutting edges of the attached die.

If there is no hole in the bolster plate through which the blank can drop, a blank channel may be provided in the die-shoe. This should be somewhat wider than the blank and extend from the drop-through core to the rear side of the die-shoe. A knock-out channel is cored from the drop-through core to the front of the die-shoe. This channel need not be so wide as the blank, as it is simply used by the operator in pushing the blanks to the rear of the die.

If the stock strip is to be fed from right to left instead of from front to rear, the blank channel will extend from the drop-through core to the left and the knock-out channel to the right. The question of which way the stock strip will be fed depends upon what type of press is being used.

Commercial or "ready made" punch- and die-shoes are often used when the construction permits, if they are cheaper than shoes made in the die shop. The outside dimensions of the shoes should be as small as permissible, but must, of course, provide ample space for punches, dies, strippers, and gages.

Construction of the Punch-Shoe

The punch-shoe is usually made of cast iron. A typical punch-shoe is shown in Fig. 3. The punch and stripper are attached to the machined bottom surface of the shoe. A cylindrical boss called the shank extends upward and fits into a hole in the ram of the press. Sometimes this shank is omitted and the punch-shoe is fastened with screws to the press ram, it being provided with a clamping flange for this purpose. If the punch-shoe is large, it should have chain slots, the same as the die-shoe, to facilitate lifting by a crane.

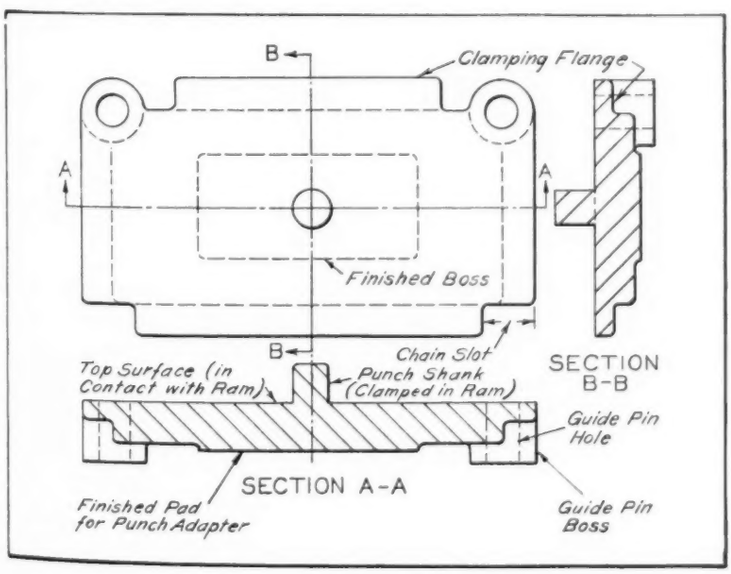


Fig. 3. Design of the Upper or Punch Shoe

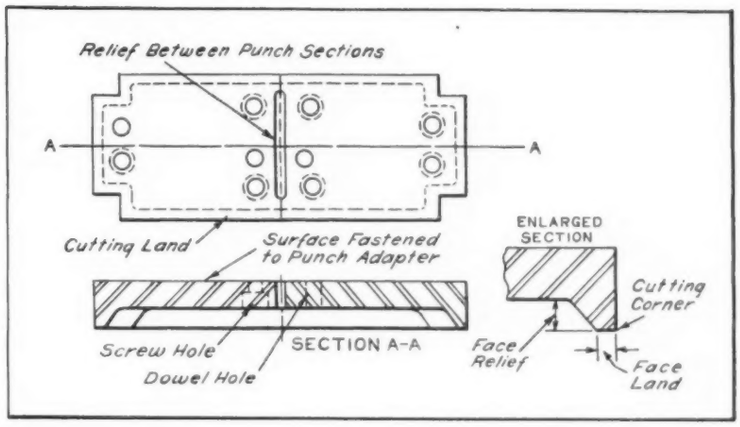


Fig. 4. Punch Made in Two Sections

The bosses for the guide pins must be high enough to provide the necessary length of sliding bearing surface for the guide pins, which should extend about 1/2 inch from the top surface of the punch-shoe when the die is in the closed position. In the open position, the guide pins frequently come clear of the punch-shoe, depending on the stroke of the press.

Construction of the Punch Member

The punch member is made of hardened tool steel, which may be bar stock, composite steel, or a hardened steel casting. For a small part, the punch unit would be made from one piece; but for larger blanks, it might be made in sections, as indicated in Fig. 4, in order to avoid warping during hardening. If two or more punch sections are used, it is customary to mount them on a plate of cast iron or boiler plate, called an adapter. The punch is then still a single unit, independent of the punch-shoe. The punch is, obviously, identical in size and shape with the blank, since it determines the size of hole blanked in the stock strip.

The usual finished cross-sectional size of punch sections made from bar stock varies from 1 3/8 inches thick by 2 3/8 inches wide, using 1 1/2- by 2 1/2-inch stock, to 1 7/8 inches thick by 2 7/8 inches wide, using 2- by 3-inch stock. The sections are usually limited to 12 inches in length to avoid excessive warping and shrinking in hardening. The punch is relieved on the face, leaving about 3/8 inch width of top cutting surface, known as "land." This relief reduces the area of the punch to be reground when it requires sharpening.

Composite Steel Punches

A composite steel punch consists of a vertical blade of hardened tool steel welded to a soft steel base. The tool-steel blade can be forged to the shape of the blank outline. It is then welded

to the soft steel base by a butt-welding process. With this construction, there is less waste stock to be machined away than with a punch made from bar stock. There is also the advantage that the dowels and screws used for fastening the sections to the shoe casting pass through a soft steel base. If it is ever necessary to relocate the section for adjustment or for a change in the blank size, new dowel holes can be drilled in the soft steel base without annealing the section.

Before a blanking die can be designed, the shape and size of the blank must be definitely determined. This is not always an easy matter, since the blank itself is not generally the finished product, but merely the first step in the procedure of making a drawn shape. The development of the size of the blank must be accurate enough for making patterns for the punch- and die-shoe or for ordering steel sections, but it does not have to be accurate enough for making the final die itself. A sheet-metal sample is usually made for that purpose.

The punch sections are fastened to the punch adapter with screws and dowels. The heads of the screws should be in the punch and the threads in the adapter, if possible. The size and number of the screws and dowels depend upon the thickness of the stock being blanked. For blanking heavy stock, keys are sometimes used back of sections that are not backed up by other parts of the punch member. The operation of blanking creates sidewise thrust as well as downward thrust. The side thrust increases as the cutting edge of the punch sections becomes rounded through wear. The ends of adjoining punch sections are relieved so that they fit each other for a short distance only. This reduces the area to be accurately fitted at the ends of the sections. The die designer should always keep in mind economy in die construction.

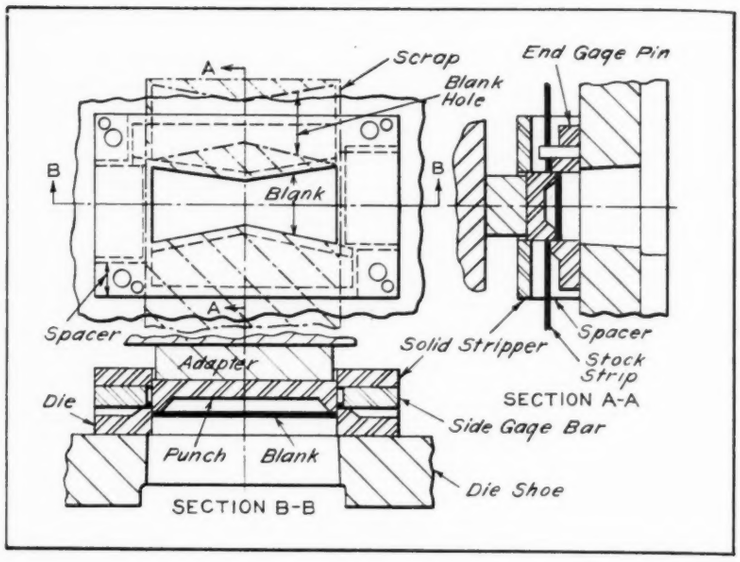


Fig. 6. Construction of Die with Solid Stripper

The die is made of the same type of material as the punch. In addition to the face relief, the cutting walls of the die are relieved sidewise to about 3/8 inch below the cutting edge, as indicated in Fig. 5. This distance is called the "vertical land." The relief is provided either by a taper of about 3 degrees or by an offset about 1/8 inch in depth. The purpose of this relief is to allow the blank to drop through the die freely.

There is also a side or die clearance between the punch and die side walls, the width of this clearance being approximately 10 per cent of the stock thickness. For example, if the stock is 0.031 inch thick, the width of the clearance all around the punch is 0.003 inch. This clearance is not usually shown on the die drawing.

The top surface or land of the die is shown on the drawing as if it were flat, but actually the cutting face should be wavy. These waves are ground in a somewhat arbitrary manner after the die is completed, the operation being known as providing "shear" for the die. This shear is usually three times the stock thickness in depth. There is no accuracy required in the spacing of the high points of the shear. The shear on the top surface of the die does not affect the flatness of the blank, since the blank is in contact with the punch; but it causes the stock scrap to be somewhat wavy. On an assembled die drawing, the punch should be shown to extend into the opening of the die a distance equal to the depth of the shear plus 1/16 inch. It will actually extend into the die opening that distance at the high points of the shear only, the distance being only 1/16 inch at the low points.

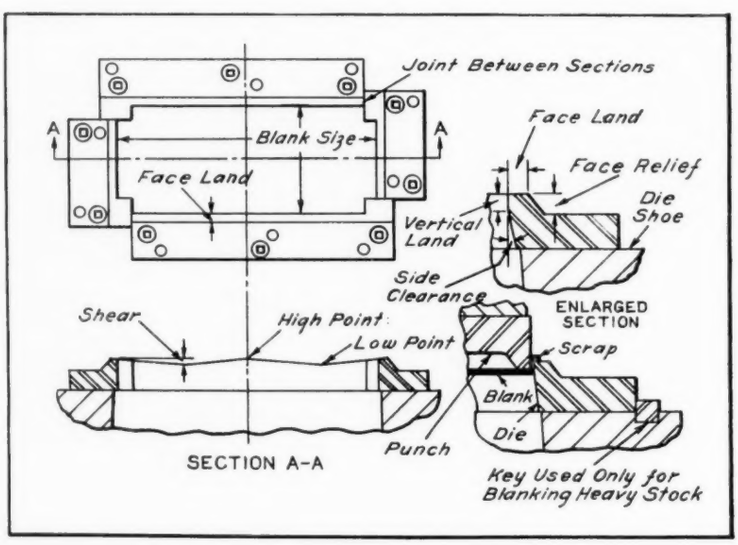


Fig. 5. Views Showing Shear, Face Relief, and Side Clearance of Die

Calculating the Pressure for Blanking

For blanking ordinary sheet steel, the approximate pressure, in pounds, may be found by the formula:

$$P = 50{,}000\ LT$$

in which P = pressure, in pounds, required for blanking;
L = circumference of blank, in inches; and
T = thickness of stock, in inches.

This formula applies to a die having no shear. If the die has shear, the blanking pressure is not applied simultaneously around the entire blank outline. In that case, the constant 50,000 may be reduced to 25,000.

Design of the Stripper

The stripper is usually made from boiler plate or cold-rolled steel and attached to the punch-shoe with retainer screws. It is normally forced down against the heads of the retainer screws by compression springs. When the punch-shoe is in the up position—that is, when the die is open—the bottom surface of the stripper is slightly below the bottom surface of the punch.

The stripper springs have an initial compression of at least 1/4 inch; in other words, the springs are compressed 1/4 inch when the stripper rests against the heads of the retainer screws. On the down stroke of the punch-shoe, the stripper comes in contact with the stock strip that rests on top of the die. As the down travel continues, the stripper springs are compressed. After the blank has been punched, and the punch-shoe starts its upward travel, the spring pressure against the stripper plate holds the stock strip down against the top of the die, stripping it off the punch. When the punch-shoe has traveled up far enough so that the retainer screws bottom in the punch-shoe, the stripper travels with the shoe.

The number of springs required may be determined by calculating the stripping pressure by the following formula: $S = 2500\ LT$, where S = stripping pressure, in pounds; L = total circumference of blank, in inches; and T = thickness of blank, in inches. Data relating to spring compression can be obtained from engineering handbooks or spring catalogues.

The punch-shoe is counterbored for the spring pockets. If the pockets are sufficiently deep to guide the spring, it is not necessary to counterbore spring pockets in the stripper plate; otherwise, shallow spring pockets should be counterbored in the stripper.

The stripper retainer screws are shoulder screws, available in standard lengths. The depth of the retainer screw counterbore in the punch-shoe determines the stripper travel. While the heads of the retainer screws are usually in the punch-shoe, there is an advantage, in the case of a large die, in having the heads of the screws in the stripper rather than in the punch-shoe, so that the stripper can be removed without taking the die out of the press. There may be a 1/16-inch clearance all around, between the hole in the stripper and the sides of the punch, since the stripper only strips off the scrap.

In case it is not convenient to provide enough springs for the proper operation of a spring stripper, a solid stripper may be used, consisting of a plate spaced above the top surface of the die by a side gage-plate on each side of the stock, as indicated in Fig. 6. The thickness of these gage-plates should be sufficient so that the stock strip can be lifted over the end gages without interfering with the stripper plate. The solid stripper plate is fastened with screws and dowels to the die-shoe through the side gage-plates and spacer blocks indicated in Fig. 6. The side gage-plates, obviously, are for the purpose of guiding the stock strip on each side. On the up stroke of the punch, the stock strip moves upward until it comes in contact with the stripper plate, when it is stripped off.

A die with a solid stripper has the disadvantage that the operator is not able to see the stock strip, since it is covered by the solid stripper plate; hence, the stock strip is not easily controlled when the last piece is being blanked from a strip, or when sight-gaging for the first piece of a strip. The solid type stripper, therefore, is not generally used, except on heavy stock, when very great spring pressure would be required for a spring stripper.

An automatic trigger-end gage may be used instead of a solid-end gage-pin. In that case, it is not necessary for the operator to lift the stock strip over the end gage. The solid stripper plate may be spaced about one and one-half times the stock thickness above the upper surface of the die. The advantage of limiting this space to less than twice the stock thickness is to prevent a new stock strip from jumping over the old strip, when the new strip is being used to push the old one through. The trigger type gage will be referred to in a coming article.

The Punch Adapter

If the punch is built up from two or more sections, the sections are usually fastened to a punch adapter, so that the punch will be a single unit. This adapter can be dispensed with at the expense of die-fitting time, if there is not sufficient vertical space available. In that case, the punch sections are fastened directly to the punch-shoe.

The adapter should be of somewhat smaller outline than the punch, so that the latter overhangs about 1/8 inch. If the blank development is uncertain or its shape is intricate, it is best not to make the pattern for the adapter casting until after the blank development has been definitely determined. Another method is to leave sufficient metal on the sides to be finished off after the casting is made. If the adapter is made from steel, it can be machined to size after the blank size has been definitely determined.

The next installment of this series will deal with guide pins, stop-collars, stock supports, and gages.

Grinding Taps From Solid Carboloy

By GEORGE EGLINTON, Vice-President
Lincoln Park Tool & Gage Co., Lincoln Park, Mich.

SUCCESSFUL application of Carboloy cemented tungsten carbide in the making of gages and special tools recently led the Lincoln Park Tool & Gage Co., Lincoln Park, Mich., to attempt the manufacture of small-diameter taps from the same material. As a result, Carboloy taps are now regularly made by the concern for tapping porcelain spark plug insulators in the prefired condition. The abrasive nature of the material from which these insulators are made causes excessive wear of ordinary high-speed steel taps, whereas the tungsten-carbide taps last a minimum of 150 times as long.

Taps of 0.150 inch outside diameter, with twenty-two, twenty-four, and thirty-six threads per inch, have been made by the concern. They are ground from blanks supplied by the Carboloy Company, which consist of a shank having an integral larger end on which the tapping threads are to be ground. This larger end is sintered with six lengthwise grooves which give it a cross-section that resembles a spline shaft or a small spur gear. By making the blank in this manner, the time for grinding in the flutes of a tap is greatly reduced. One of these blanks is seen at *A* in Fig. 2. They have an overall length of approximately 1 7/8 inches.

The first finishing operation on these blanks is to lap a male center on one end and a female center in the opposite end, so as to insure concentric rotation in the subsequent operations. Then the thread diameter and the shank are ground to size on a cylindrical grinding machine equipped with a diamond grinding wheel. Finally, the tap threads are ground on the grooved end with the tap held in the fixture shown in Fig. 1.

This fixture is equipped with a lead-screw having a thread ground to the same lead as the threads to be produced on the tap. The lead-screw engages a nut which is held stationary in the fixture and is of such construction as to absorb all backlash. The lead-screw is hollow and is provided with a draw-in collet at the front end to receive the tap shank. By merely turning the handle on the plate at the left-hand end of the lead-screw, the tap is rotated and at the same time fed across the diamond grinding wheel at the proper rate for grinding the threads to the desired lead.

The practice is to grind to a depth of about 0.002 inch with each pass of the tap across the wheel and to dress the wheel four times during the complete grinding of a tap. The length of the threaded portion is about 5/16 inch. The grinding wheel is 3 inches in diameter by 3/16 inch thick and runs at 2700 revolutions per minute. The work fixture is set up on the magnetic chuck of the surface grinding machine with the axis of the tap inclined relative to the grinding wheel spindle at the helix angle of the thread to be produced. Kerosene is brushed on the wheel and work during the thread-grinding operation.

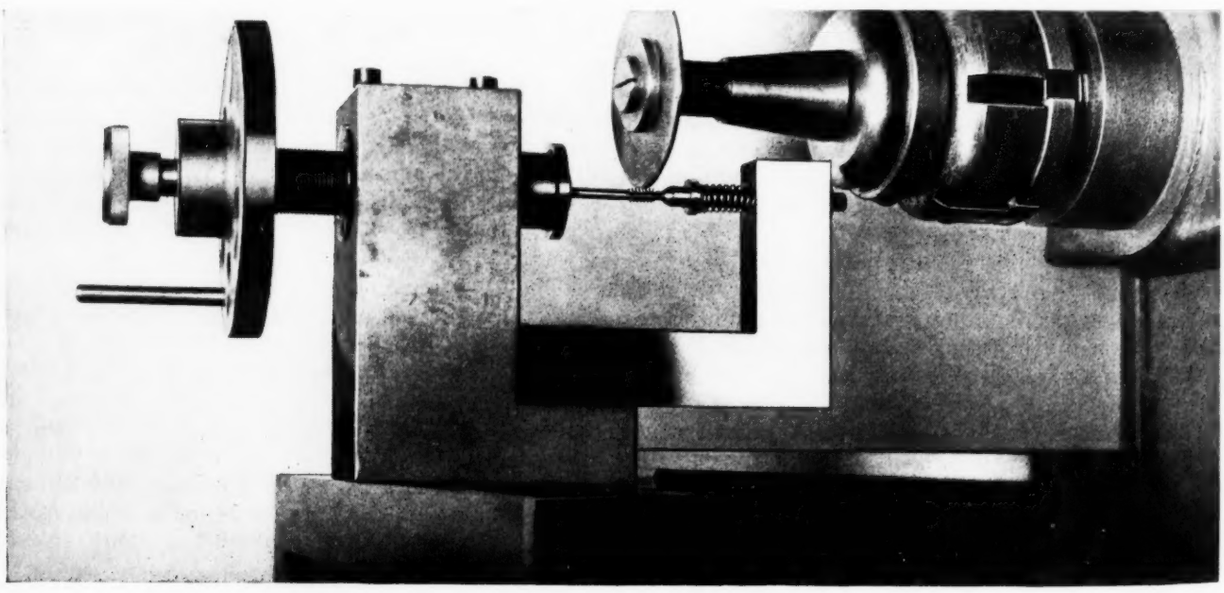


Fig. 1. Grinding Threads on a Small Tap of Solid Carboloy Cemented Tungsten Carbide

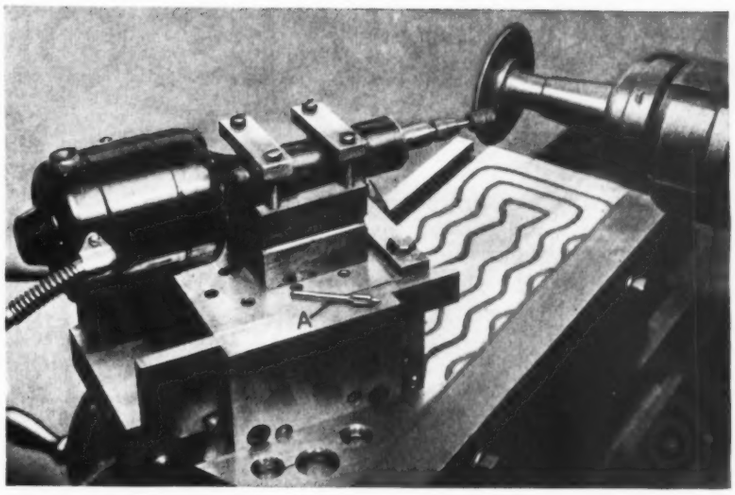


Fig. 2. Equipment Employed in Dressing the Diamond Grinding Wheel which Produces Threads in Tap Blanks Such as Seen at A

Dressing of the diamond grinding wheel is accomplished in the manner illustrated in Fig. 2 by applying a fine-grain silicon wheel about 1/2 inch in diameter by 1/2 inch long. This wheel is mounted on the spindle of a Dumore hand grinder which runs at 25,000 revolutions per minute. The grinder is clamped to the table of a fixture which is positioned on the magnetic chuck of the machine at the correct angle for grinding the diamond wheel to the required V-shaped edge. The table of the fixture slides on preloaded balls held in V-grooves on each side of the fixture base, thus providing for easy movement of the grinding unit by hand to feed the dressing wheel back and forth across the diamond wheel. Careful construction of the fixture has eliminated sway of the dressing wheel spindle in any direction.

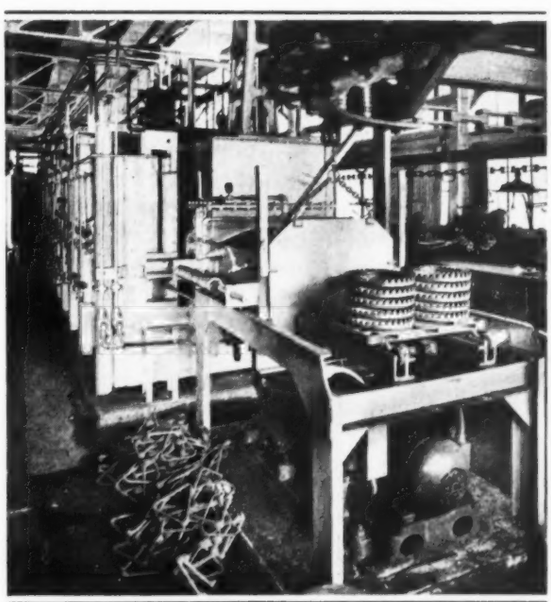
Dry Cyaniding—A New Casehardening Process

CASEHARDENING by a process known as dry cyaniding, which combines continuous nitriding and continuous gas carburizing to produce a case that is similar in many respects to a cyanide case, is being announced by the Surface Combustion Corporation, Toledo, Ohio. Unlike ordinary cyaniding, this process is carried out in a gaseous atmosphere which is a combination of carburizing gases and ammonia. This gaseous atmosphere can be varied to produce a case having any desirable concentrations of carbides and nitrides, and ranging in depth from a few thousandths inch to any desirable amount.

In an extensive series of tests, cases have been produced by this process on a variety of SAE steels at different temperatures. It has been found that a case can be produced at a temperature as low as 1150 degrees F. Many of the specimens were found to be quite hard without quenching.

The equipment necessary for dry cyaniding is similar in many respects to that used for continuous gas carburizing. The work is loaded on trays and pushed through a muffle furnace in a continuous cycle. Atmosphere seals at both ends of the furnace prevent the infiltration of air. The work is clean upon emerging from the furnace, so that no brushing is required.

The advantages of this process are (1) that it is continuous and can be placed in a production line; (2) a highly uniform case is produced, owing to the fact that the process is continuous; (3) the character and depth of the case can be definitely controlled; (4) in certain applications a sufficiently hard case can be obtained without quenching; (5) working conditions are clean and (6) the costs of dry cyaniding are comparatively low. The process is carried on at a relatively low temperature that promotes long life of the muffle and other alloy parts.

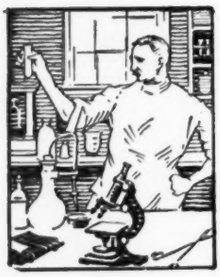


Furnace Installation of the Type Required for Dry Cyaniding in a Combination of Carburizing Gases and Ammonia

* * *

It is the extreme of optimism to assume that inexperienced Government officials can do for industry what industry up to the present, with its best efforts, has been unable to do for itself.

MATERIALS OF INDUSTRY

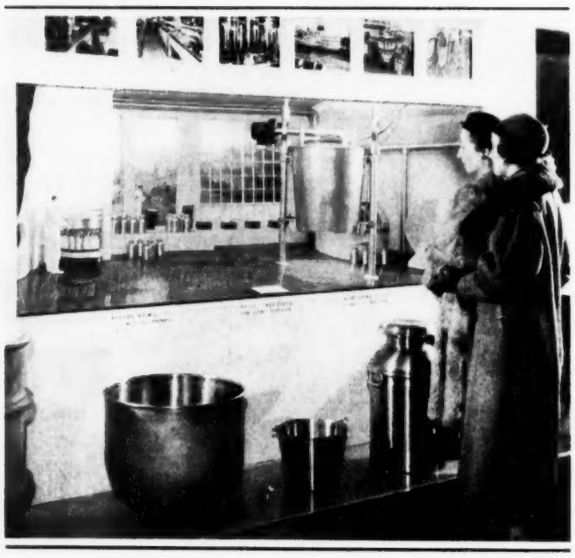


THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Stainless Steel Exhibit in New York City

An exhibit of stainless steel was recently opened in the New York Museum of Science and Industry, RCA Bldg., Rockefeller Center, New York City, under the joint sponsorship of the Museum and the Electro Metallurgical Co., Unit of the Union Carbide & Carbon Corporation. This exposition shows the history, development, production, fabrication, and uses of stainless steel. It includes hundreds of stainless steel products lent by manufacturers, which are used in the home and in food-handling, building, transportation, and other industries. Special units of the exposition are devoted to these major fields, and attention is also given to stainless steel medical and dental equipment.

The exposition illustrates how the combination of physical and chemical characteristics in stainless steel make it adaptable to strong light-weight structures, equipment operated under high temperatures, and architectural uses. Steps in the production and fabrication of stainless steel are graphically illustrated, and motion pictures show tests made to determine the strength and toughness. 101



Stainless Steel Equipment on Display at the Stainless Steel Exposition in New York City

Sprocket Couplings Made of Celeron

Sprocket couplings are being made by the Continental Diamond Fibre Co., Newark, Del., consisting of a female part molded of macerated Celeron and a male member of steel. These couplings are available in sizes from 2 to 7 1/2 inches pitch diameter. Light weight is an important feature, the total weight of both the male and female coupling parts being less than one-half the weight of two- or three-piece metal couplings having the same load-carrying capacities. Simplicity of construction and strength are additional features. In tests, the steel shaft to which the Celeron member was attached, broke before either the teeth or keyway of this member was fractured. 102

An Enamel for Insulating Chromium-Plating Racks

An enamel for insulating all but the contact points of racks used in chromium-plating has been developed by the Maas & Waldstein Co., Newark, N. J., and placed on the market after tests in actual plating service. This enamel reduces the dissipation of electric current. It is applied by dipping the racks (with the contact points protected by tape) into the enamel.

Three or four coats should be applied at intervals of about two hours. After the final application, the coating becomes hard enough for use, if force-dried for two hours at 150 degrees F. or air-dried for twenty-four hours. The enamel can be supplied in red and black. 103

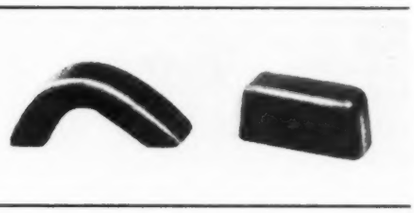
Synthetic Rubber Wipers Keep Lathe Ways Clean

Wipers made of Duprene (now called Neoprene by the makers, E. I. du Pont de Nemours & Co.) are now being supplied on the carriage wings and tailstock base of lathes built by the Monarch Machine Tool Co., Sidney, Ohio. These wipers replace the

To obtain additional information about materials described on this page, see lower part of page 396.

felt wipers used heretofore on Monarch lathes.

The new synthetic rubber wipers are not affected by oil, acid, or other liquids, and are said to last indefinitely. Experiments have shown that the wiping surface of Duprene does not absorb any grit, dirt, or abrasive and therefore never has to be cleaned. This prolongs the life of lathe beds and eliminates the possibility of scratched or scored ways. The wipers are compressed in being installed, insuring close contact against the ways. 104



Synthetic Rubber Wipers Provided on Monarch Lathes

Cellulose Plastic Coating for Metal, Wood, and Rubber

A cellulose plastic coating that can be applied on metal, wood, and rubber by either spraying or dipping has been developed by the Detroit Macoid Corporation, 12340 Cloverdale Ave., Detroit, Mich. This process is being used to a considerable extent at present on automobile hardware, including such parts as window regulators, door handles, and control knobs. Molded-rubber steering wheels are also treated by the process to produce colors that match car interiors.

Coatings used for dipping are known by the trade name "Macoid," while the coating materials applied in spray guns are called "Cellucraft." Bright colors, pastel shades, "metaltones" and other effects are obtained by pigmenting the coating material. Certain pigments impart transparency to the coating and the finish of the base material can be clearly seen. When opaque coatings are to be used on die-castings, no treatment of the castings is necessary except the removal of the fins and the polishing of the parting line. When a transparent effect is desired, the casting is buffed after polishing.

The plastic coating, when cured, is flexible and shrinks tenaciously about the surface to which it is applied, so that pretreatment of the surface is not essential. 105

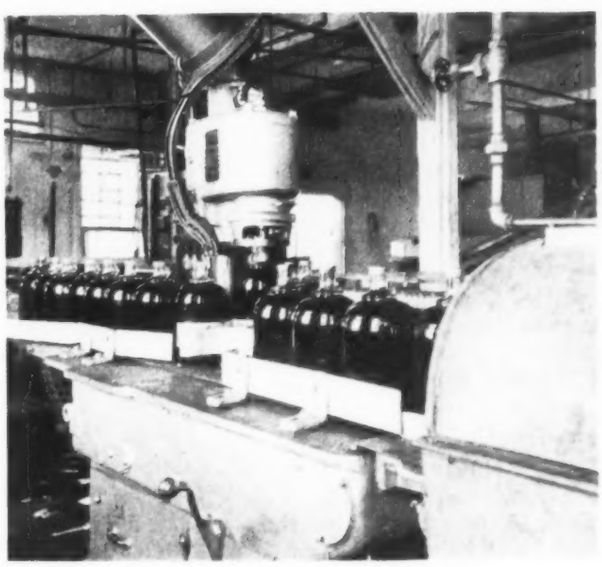
Belmalloy—A Pearlitic Malleable Iron

The recently developed pearlitic malleable irons constitute a distinct class of ferrous castings between regular malleable iron and steel. They possess physical properties that approach those of medium carbon steel castings. Their structure differs radically from regular malleable iron, due to the alloys that they may contain, to the heat-treatment to which they are subjected, or to both.

Pearlitic malleable irons may be classified into three general types, depending upon the method used to produce the final structure. (1) The heat-treatment may be interrupted before graphitization is complete. (2) The castings may be completely graphitized and then given a second heat-treatment to produce the desired structure. (3) Alloys may be added to the melt and the annealing process or heat-treatment regulated so that most of the carbon is retained in the combined form with a pearlitic structure.

The Belle City Malleable Iron Co., Racine, Wis., has placed on the market a pearlitic malleable iron known as Belmalloy, which has physical properties developed by an electric melting and continuous annealing process that are similar in many respects to the properties of 0.40 per cent carbon cast steel. For example, the tensile strength of Belmalloy ranges from 70,000 to 80,000 pounds per square inch, and the yield point from 45,000 to 50,000 pounds per square inch. The shearing strength is approximately 60,000 pounds per square inch. The elongation ranges from 5 to 10 per cent, and the hardness is from 179 to 207 Brinell.

Belmalloy can be machined from 25 to 40 per cent more easily than steel castings, although not so easily as regular malleable-iron castings. The annealing process to which castings of this material are subjected relieves all internal stresses that might later cause distortion. The castings will stand considerable heat and, in fact, can be heated intermittently up to 1200 degrees F. without material changes in dimensions. The relatively high fluidity at pouring temperatures results in a sharp delineation of pattern design and a smooth surface finish. 106



A Bottle Sealing Machine on which an Aluminum Starwheel is Used because of Its Low Inertia

To obtain additional information about materials described on this page, see lower part of page 396.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 395 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the February Number of MACHINERY

Carboloy Dies

CARBOLOY COMPANY, INC., 2987 E. Jefferson Ave., Detroit, Mich. Carboloy Die Service Manual DS-711, illustrating and describing each stage in the process of making Carboloy drawing and sizing dies, from the rough-cored and "blank" dies up to the finished state. A new price list D-37 is available containing recent price reductions. 1

Welding Equipment

LINCOLN ELECTRIC CO., 12818 Coit Road, Cleveland, Ohio. Bulletin 420, entitled "How to Change Over to Welded Design for Profits." This book is intended as an aid in applying electric welding to the design of machines and machinery structures. It sets forth actual savings that have been made by redesigning products for arc-welded construction. 2

Seamless Tubing

TIMKEN STEEL & TUBE DIVISION of the TIMKEN ROLLER BEARING CO., Canton, Ohio. Booklet listing standard tolerances and mechanical properties of seamless mechanical tubing, as well as theoretical weights per lineal foot of seamless tubing from 1/8 inch to 10 3/4 inches outside diameter, with wall thicknesses from 0.004 inch to 1 5/8 inches. 3

Durez Molding Compounds

GENERAL PLASTICS, INC., North Tonawanda, N. Y. Catalogue on Durez molding compounds, describing the properties, advantages and limitations, and applications. Products List of Durez molding materials, containing data on physical properties, plasticity, heat resistance, etc., as well as information on applications of the various Durez molding compounds. 4

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Folder F-T625 (5) entitled "Tempering as Jacobs Likes it in the Modern Homo Furnace," giving the important details of the process of tempering machine tool chucks by the Homo method. A brief description of the furnace is included. 5

Contour Sawing and Filing Machines

CONTINENTAL MACHINE SPECIALTIES, INC., 1301 S. Washington Ave., Minneapolis, Minn. Catalogue entitled "25 Ways to Cut Machining Costs," containing case records of the actual savings made by users of Doall contour machines. 6

Pressure-Producing Device

LINDERMAN DEVICES, INC., 149 Broadway, New York City. Circular illustrating the "Multi-Stage Diaphragm" and describing its application to problems of applying pressure or converting pressure into motion. Typical uses include brakes, clutches, holding fixtures, jacks, etc. 7

Indicating and Recording Instruments

BROWN INSTRUMENT CO., Wayne and Roberts Ave., Philadelphia, Pa. Folder 84-9, entitled "Legibility Plus Precision," reproducing the colored numeral records exactly as they are printed on the chart of the Brown potentiometer pyrometer recorders. 8

Grinding Wheels

ABRASIVE CO., DIVISION OF SIMONDS SAW & STEEL CO., Tacony and Fraley Sts., Philadelphia, Pa. Bulletin on centerless grinding wheels, with particular reference to K Bond Borolon vitrified wheels, containing recommendations for the wheel to use for various classes of work. 9

Ball Bearings

NEW DEPARTURE DIVISION OF GENERAL MOTORS CORPORATION, Bristol, Conn. Booklet R-9, containing numerically arranged lists of ball bearings made by various manufacturers, together with the corresponding numbers of interchangeable New Departure bearings. 10

Power Transmission Equipment

BOSTON GEAR WORKS, INC., North Quincy, Mass. Catalogue 52, covering the complete line of transmission equipment made by this concern, including ball bearings, chains and sprockets, couplings, belts, gears, speed reducers, etc. 11

Lapping Compounds

NATIONAL BROACH & MACHINE CO., Shoemaker and St. Jean, Detroit, Mich. Circular entitled "Fast and Economical Precision Lapping," describing Red Ring lapping compounds, of which eight different types and grades are available to meet different requirements. 12

Presses and Shears

NIAGARA MACHINE & TOOL WORKS, 637 Northland Ave., Buffalo, N. Y. Booklet 106, containing a condensed description and illustrations of the complete line of Niagara presses, shears, and machines for shearing, blanking, drawing, and forming sheet and plate metal. 13

Rubber Hose

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J. Folder showing a variety of installations of Manhattan and Condor hose being used in a wide range of industries. Detailed descriptions of the various types are included. 14

Metallizing Equipment

METALLIZING ENGINEERING CO., INC., 44 Whitehall St., New York City. Booklet entitled "Metal Sprayed

Surfaces in Relation to Lubrication," describing the results of tests made to determine the behavior of metal-sprayed surfaces as journal and bearing surfaces. 15

Nickel Alloys

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Circular containing a complete list of the literature issued by the company on production and industrial applications of the nickel alloy steels, nickel cast irons, and nickel alloyed non-ferrous castings. 16

Grinding Wheels

AMERICAN EMERY WHEEL WORKS, Providence, R. I. Catalogue 10, entitled "Grinding Wheel Guide," containing a brief description of the line of grinding wheels made by this concern and grain and grade recommendations for common operations. 17

Universal Joints and Flexible Drive Shafts

MECHANICS UNIVERSAL JOINT DIVISION OF THE BORG-WARNER CORPORATION, Rockford, Ill. Catalogue covering this company's line of roller-bearing universal joints and flexible drive shafts. 18

Bronze Bearings

JOHNSON BRONZE CO., 530 S. Mill St., New Castle, Pa. Loose-leaf sheets covering the bronze bearing sleeves made by this company. The data includes design, lubrication, chemical and physical properties, and the various types of bearings. 19

Roll Grinders

LANDIS TOOL CO., Waynesboro, Pa. Catalogue V-37, illustrating and describing the Landis Type 30 roll grinders, designed for grinding the larger hot and cold sheet and plate rolls with either straight, concave, or crowned bodies. 20

Bearings

FAST BEARING CO., Baltimore, Md. Catalogue describing the outstanding features of Fast precision oil-film bearings. The results of tests made on these bearings, installation photographs, and complete dimension and load data are included. 21

Pantograph Machines

GEORGE GORTON MACHINE CO., 1109 Thirteenth St., Racine, Wis. Catalogue 1322A, describing the construction and advantages of the Gorton new three-dimensional pantographs for the reproduction of intricate dies and molds. 22

Lubricants

SUN OIL CO., Philadelphia, Pa. Lubrication Handbook, listing lubricants recommended for air compressors, electric generators, steam engines, Diesel engines, pumps, and coal mining equipment. 23

Roller Bearings

SHAFER BEARING CORPORATION, 35 E. Wacker Drive, Chicago, Ill. Catalogue 14 covering the line of roller bearings made by this concern. Complete specifications, including load ratings, as well as engineering data, are given. 24

Pneumatic Die Cushion

DAYTON ROGERS MFG. CO., Minneapolis, Minn. Catalogue illustrating and describing a new improved universal pneumatic die cushion. The bulletin shows various applications and actual installations, and includes production records. 25

Wire, Rod, and Strip

ALLOY METAL WIRE CO., Prospect Park, Pa. Catalogue C-1, containing information on non-corroding, acid-resisting wire, rod, and strip for use in the mechanical, electrical, and chemical fields. 26

Hydraulic Presses

HYDRAULIC PRESS DIVISION OF THE FRENCH OIL MILL MACHINERY CO., Piqua, Ohio. Catalogue covering this company's line of hydraulic presses and hydraulic press controls. 27

Machine Tools

ATLAS PRESS CO., 1819 N. Pitcher St., Kalamazoo, Mich. General catalogue No. 28, covering the Atlas line of shop equipment, including lathes, drill presses, shapers, etc. 28

To Obtain Copies of New Trade Literature

listed on pages 394-396 (without charge or obligation) mark with X in squares below, the publications wanted, using the identifying numbers at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	

Name..... *Position or Title*.....

[This service is for those in charge of shop or engineering work]

Firm.....

Business Address.....

City..... *State*.....

[SEE OTHER SIDE]

Precision Lathes

SOUTH BEND LATHE WORKS, 720 E. Madison St., South Bend, Ind. Catalogue 46, illustrating and describing the new 1938 model South Bend 9-inch "Workshop" precision lathes. 29

Rotary Tools

AMERICAN ROTARY TOOLS CO., INC., 44 Whitehall St., New York City. Catalogue covering the line of Artco tools, including burrs, rotary cutters, files, grinding wheels, etc. 30

Tantaloy-Tipped Tools

FANSTEEL METALLURGICAL CORPORATION, North Chicago, Ill. Bulletin on Tantaloy-tipped tools, containing a description of Tantaloy and a table of standard tool and tip prices. 31

Lubricating Systems

BIJUR LUBRICATING CORPORATION, Long Island City, N. Y. Bulletin F, describing the construction of the Bijur automatic lubricating system for all types of bearings. 32

Forged Tools

BILLINGS & SPENCER CO., Hartford, Conn. General catalogue 1937-1938 covering Billings & Spencer merchandise forged tools, including the new line of Vitalloy wrenches. 33

Self-Lubricating Bearings

BOUND BROOK OIL-LESS BEARING CO., Bound Brook, N. J. Catalogue containing data on Compo self-lubricating porous bronze oil-retaining bearings. 34

Hand Grinders

DUMORE CO., Racine, Wis. Folder entitled "The Handiest Tool in the Shop," containing information on the Dumore No. 8 hand grinder and illustrating its use on shop jobs. 35

Lubricants

E. F. HOUGHTON & CO., 240 W. Somerset St., Philadelphia, Pa. Booklet entitled "Less Oil—Less Often," containing information on high film-strength lubricants. 36

Sensitive Drilling Machines

ADOLPH MUEHLMATT DIVISION OF THE HAMILTON TOOL CO., Hamilton, Ohio. Bulletin illustrating and describing the A. M. "Maxi-Jr." supersensitive drilling machine. 37

Rack Shapers

FELLOWS GEAR SHAPER CO., Springfield, Vt. Circular illustrating and describing the Nos. 3-48 and 3-60 Fellows rack shapers for cutting spur and helical tooth racks. 38

Pipe Cutting and Threading Machines

CURTIS & CURTIS CO., Bridgeport, Conn. Catalogue covering this company's line of pipe cutting and threading machines. 39

Portable Electric Drills

INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, Ill. Leaflet illustrating and describing the new Thor U44 1/2-inch portable electric drill. 40

Electric Heat-Treating Furnaces

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEA-2790, on electric furnaces for scale-free hardening. 41

Milling Cutters

GAIRING TOOL CO., INC., Detroit, Mich. Circular illustrating and describing Gairing milling cutters with the new Gair-Lock all-purpose blade. 42

Air Compressors and Pumps

INGERSOLL-RAND CO., 11 Broadway, New York City. Bulletin 2118, on Ingersoll-Rand small compressors and vacuum pumps for industrial use. 43

Inserted-Tooth Saws

PITTSBURGH TOOL-KNIFE & MFG. CO., Pittsburgh, Pa. Circular describing the features of the Pittsburgh inserted-tooth saw. 44

Heat-Treating Furnaces

AMERICAN GAS FURNACE CO., Elizabeth, N. J. Catalogue on American heat-treating furnaces and machines. 45

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 397-414 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 397-414—or write directly to the manufacturer, mentioning machine as described in February MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 392-393 mark with X in the squares below, the identifying number found at end of each description on pages 392-393—or write directly to the manufacturer, mentioning name of material as described in February MACHINERY.

101	102	103	104	105	106

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Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Shaving Machine for Flat and Cylindrical Surfaces

A machine for shaving both cylindrical and flat surfaces of metal parts, which operates on the same principle as the gear-tooth shaving machines developed in recent years, has been built by the National Broach & Machine Co., 11457 Shoemaker Ave., Detroit, Mich. This machine is designed to finish one or more bearing or locating surfaces, in order to provide the necessary accuracy for subsequent operations, especially gear-tooth cutting. Metal surfaces as hard as 38 Rockwell C can be finished by this method.

The machine is 16 feet high. It produces at the rate of one part every seven seconds within dimensional and alignment limits of 0.001 inch. The machine is constructed with a stationary table or base and a rectangular column on the base which rotates about a vertical axis at the speed of one revolution every twenty-eight seconds. Each panel of the column accommodates one work unit comprising three motor-driven spindles, one for rotating the work between centers and the others for driving the cutters.

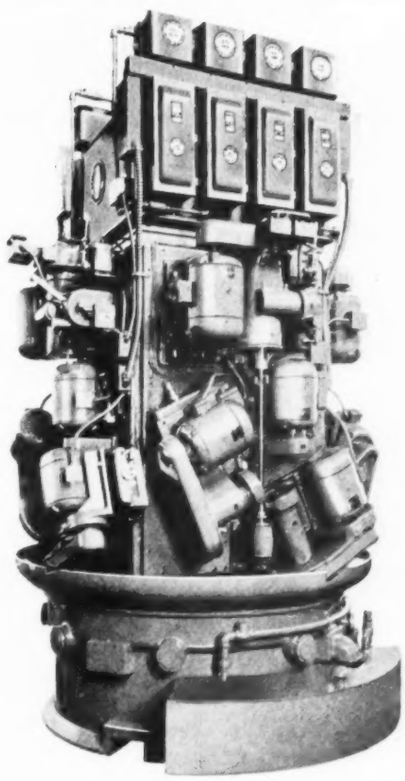
Cutting begins immediately after the operator has placed a work-piece between centers and locked it with a handle. It continues as the column rotates until the panel returns to the loading position. Here the motors of that panel are automatically stopped and the work released.

One cutter of each unit shaves a cylindrical hub bearing while the other cutter finishes a flat bearing face. Both the part and the cutters are rotated at high speeds. In the particular operation illustrated, they remove stock to a depth of from 0.010 to 0.015 inch from the flat surface, and 0.020 to 0.030 inch from the cylindrical surface.

The cutters are circular and of a beveled tooth form similar to that of a broach. They remove metal in the form of fine hairlike chips which are entirely different from those obtained in ordinary lathe work. They are made from Na-Loy steel, are approximately 7 inches in diameter, and have teeth of about 1/8 inch pitch. They can be readily reground after a period of service. The cutters are moved into position against the work by a cam action, so that no sudden load is thrown on the tools.

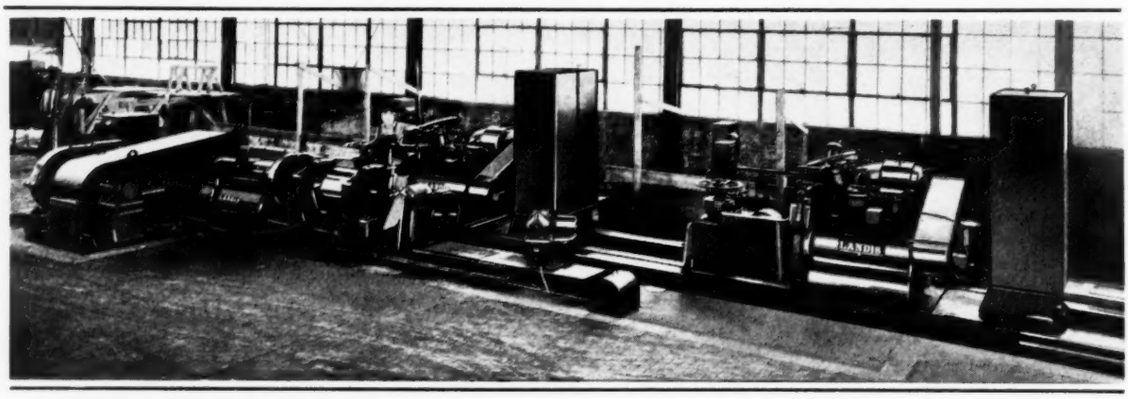
This machine is equipped with eighteen standard motors. The entire electrical system operates on 110-volt current. Relays prevent coasting when the automatic control mechanism turns off the current, the relays being housed near the top of the column.

Each panel of this machine can be operated independently, so that it is not necessary for all panels to



Continuous Rotary Machine Built by National Broach & Machine Co. for Shaving Flat and Cylindrical Surfaces

To obtain additional information on equipment described on this page, see lower part of page 396.



Landis Roll-grinder with Two Wheel-carriages for Semi-finish and Finish Grinding in One Machine

be in operation. Starting of the equipment on any panel depends entirely upon the action of the handle used for clamping the work between centers. Should the operator fail to load one panel, the unit on that panel will not operate.

Each column panel is equipped with a separate force-feed lubricating system. The coolant is under automatic control, being delivered only while cutting is actually in progress. All slides of the machine are hardened and ground. The spindles are easily adjustable for wear and changes in cutting sizes. 51

Improved Continuous Filing Band for Doall Machines

An improved file band has recently been developed by the Continental Machine Specialties, Inc., 1301 S. Washington Ave., Minneapolis, Minn., for the Doall combination sawing and filing machines. This new file is made up of short filing segments mounted on a flexible steel band, as on the previous file bands, but the ends of the segments are shaped to interlock with each other in such a way that a continuous cutting surface moves over the work without any interruption of the cut at the ends of the segments. Each segment automatically locks and lines up the next one. Unusual cutting smoothness results from the uninterrupted cutting edge. 52

Landis Dual Wheel-Carriage Roll-Grinders

Several months ago the Landis Tool Co., Waynesboro, Pa., built a roll-grinder with two wheel-carriages for grinding rolls of unusual hardness from the rough without first performing the usual turning operations, and then finish-grinding the rolls on the same machine. Another machine has now been built for semi-finish- and finish-grinding conventional types of rolls. This machine weighs approximately 185,000 pounds, including the electrical equipment. There are fifteen motors having a total rating of 96 1/2 horsepower.

The rear bed section of the machine is made extra long to accommodate the two standard wheel-carriages. Each carriage will grind a roll of the full machine capacity without interfering with the second carriage, which is always out of the way at one end of the bed or the other. Because the majority of rolls are ground to a crown or concave in both semi-finishing and finishing operations, it is necessary for the finishing wheelhead to track with close accuracy the form produced by the semi-finishing head.

The machine is equipped with the new work drive that has been adopted for all standard Type 30 roll-grinders built by the concern. This drive consists of a conventional motor mounted on a base at the left-hand end of the machine and direct-connected to a speed reducing unit. The drive is transmitted from this unit to the headstock spindle through a silent chain. The drive is compact, and as the entire base that supports it does not come into contact with the machine bed, any vibration picked up by the base will not be transmitted to the bed. The drive may be mounted on the same level as the machine or located in a pit. Under certain circumstances, however, a multiple V-belt drive may be employed.

All the motors can be controlled from the wheel-carriage in use. The wheel-carriage motors are interlocked, in order to prevent both of the carriages from being operated at the same time. 53

Govro-Nelson Automatic Drilling Unit

An automatic drilling unit for producing holes from 1/32 to 3/8 inch is being manufactured by the Govro-Nelson Co., Detroit, Mich., and marketed by the Hole Engineering Service, 1931 Antoinette St., Detroit. This drilling unit is mounted on the shaft end of a standard motor and operates at the motor speed.

Feeding pressure is produced by a set of segmental weights that are expanded radially by centrifugal force, and slide in a spacing disk between two cone members. One of the cones is

To obtain additional information on equipment described on this page, see lower part of page 396.

rigid, while the other slides on the shaft of the unit. A garter spring holds dogs on the sliding cone in engagement with a cross-key that extends through the inner spindle. As the weights move radially outward, the cones are separated and the inner spindle is moved forward to carry the drill to the work. From two to six weights, made of either duralumin or cast iron, can be used to load the drill as required for an operation.

Upon starting the motor, the tool advances quickly to the work. It will drill through one wall of work, jump through an air gap, and drill a second wall until the tool-carrying inner spindle is released. The tool is then returned to the starting point. When the electric current is shut off and the shaft speed has been reduced to a certain point, the resetting spring, which has been compressed by the sliding cone, will return the cone to its starting position. The weights are then forced toward the center of the unit and the feed-dogs are again engaged with the inner spindle, preparing the unit for the next cycle.

The illustration shows a double-end centering machine made up of two of these automatic drilling units. 54

Cincinnati Universal Grinding Machines

A new line of universal grinding machines designed to give the quality of finish and high degree of accuracy required in tool-room operations is being announced to the trade by Cincinnati Milling Machine and Cincinnati Grinders, Inc., Cincinnati, Ohio. These machines are built in 12- and 16-inch sizes and in between-center lengths of 24, 36, 48, and 72 inches.

The spindle bearing design and its lubricating system are similar to the arrangement on the Cincinnati roll and plain self-contained grinders. A small motor on the wheel-head unit draws oil from a built-in reservoir and pumps it first through a renewable filter and then to the bearings, completely filling the space around them. As soon as the pressure reaches about 4 pounds, a pressure switch starts the main drive motor.

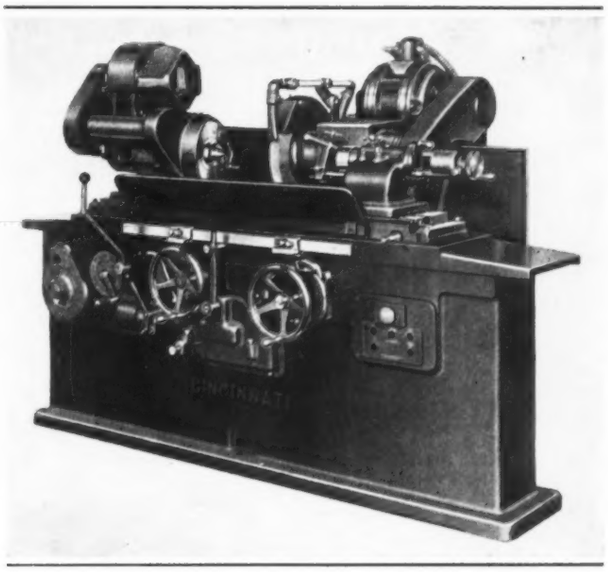
If the lubricating system should fail to function, the pressure will drop and the main drive motor will immediately be stopped. When the filter becomes clogged with dirt beyond the point of usefulness, the oil by-passes back to the reservoir, relieving the pressure and also stopping the main drive motor.

No adjustment of the bearings is necessary in changing from roughing to finishing operations or vice versa, because the bearings are self-compensating for changes in load. A motor on the wheel-head unit drives the wheel-spindle through multiple V-belts, and also drives a fixed internal attachment. The wheel-head unit can be swiveled 90 degrees either side of center.

Power is transmitted to the headstock faceplate through V-belts and a silent chain from a 3/4-horsepower variable-speed motor. This unit can be swiveled through an angle of 150 degrees for face and angle grinding. An infinite number of work speeds ranging from 60 to 240 revolutions per minute are available through a rheostat in the front of the bed. Control buttons are built into compact units that are flush with the front of the bed, and mechanical operating controls are also grouped on the front of the bed.

Motion is transmitted to the table by means of a rack and pinion, twelve traverse rates of from 4 to 63 inches a minute being available. A multiple-disk clutch eliminates reversal shocks. The table can be swiveled from

Double-end Centering Machine with Govro-Nelson Drilling Units



Cincinnati Universal Grinding Machine of New Design

To obtain additional information on equipment described on this page, see lower part of page 396.

10 degrees forward to 2 degrees back.

Work diameter reduction can be adjusted by an increment as low as 0.00025 inch through an automatic pick-feed mechanism. There is a cross-feed backlash self-adjusting arrangement. Automatic starting and stopping of coolant can be effected through a selector switch, but a hand control can also be used. These machines can be arranged with either a fixed or a swinging-frame internal grinding attachment. 55

Power-Operated Chucking Devices Brought out by the Warner & Swasey Co.

Two chucking devices intended to ease the physical burden of machine operators have been developed by the Warner & Swasey Co., Cleveland, Ohio. One of these is the power-driven chuck wrench shown in Fig. 1, and the other the power-operated bar and feed mechanism illustrated in Fig. 2.

The power chuck wrench can be attached by means of adapters to saddle type machines—either new machines or machines of recent design that are in service. It can be used on chucks from 12 to 28 inches in diameter. This wrench is intended primarily for use with three-jaw universal scroll chucks, but it can also be applied to four-jaw independent chucks or any other chuck made with radial wrench sockets.

In using the power wrench, the operator stops the chuck, lines up a mark on its periphery with a pointer indicator on the machine and engages the square end of the wrench with the socket of the chuck pinion, by pulling the wrench handle toward him. Turning this handle to the left or right turns on power for either opening or closing the chuck. An interlocking arrangement makes it impossible to engage the machine starting clutch without first withdrawing the wrench from the chuck pinion socket.

The power-driven bar chuck and feed unit is shown in Fig. 2 with the guards removed, so as to expose the mechanism and graduated feed-arm. This device can be applied to Warner & Swasey Nos. 1 and 2 electric turret lathes and to the No. 2 all-geared head turret lathe. The operating lever for controlling the device is located near the cross-slide, which is not shown. On the No. 1 machine, the device can also be tripped by the cross-slide, even when tools are used on both front and rear stations. For such fast operations as the forming and cutting off of short pins, the operator need only move the cross-slide lever.

The elements of the bar chuck and feed unit and the sequence of operations in opening the collet, feeding the stock, closing the collet, and overhauling the feed-finger are the same as with manual operation. The attachment merely substitutes a power drive, timing control, and stroke adjustment for the hand-levers of the manually operated bar chuck and feed unit. Shifting of a selector lever adapts the device instantly for either first or second operations on work. 56

Colonial Universal Broach Sharpening Machine

A broach sharpening machine that can be used for both flat and round broaches by making a few minor adjustments has been announced by the Colonial Broach Co., Detroit, Mich. This machine is provided with a grinding head that is adjustable horizontally through an arc of 180 degrees, thus permitting complete reversal of the head. It is adjustable vertically from a horizontal position to 90 degrees below horizontal.

The head is fitted with a hardened and ground slide that trav-

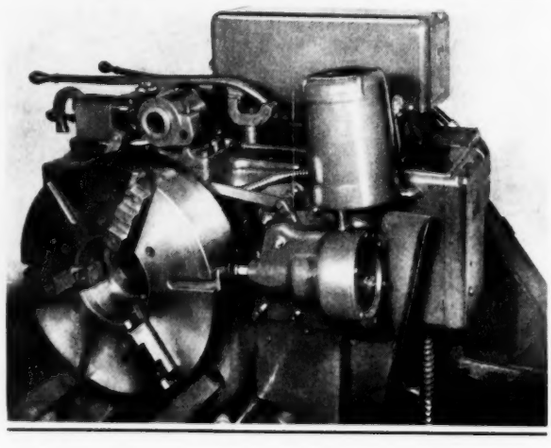


Fig. 1. Warner & Swasey Power Chuck Wrench for Application to Hand-operated Chucks

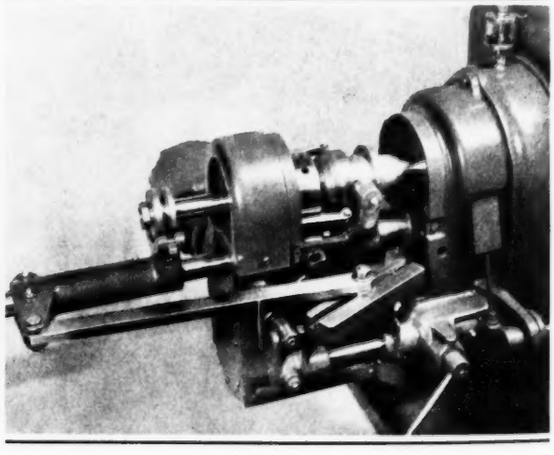


Fig. 2. Power-driven Bar Chuck and Bar Feed for Warner & Swasey Turret Lathes

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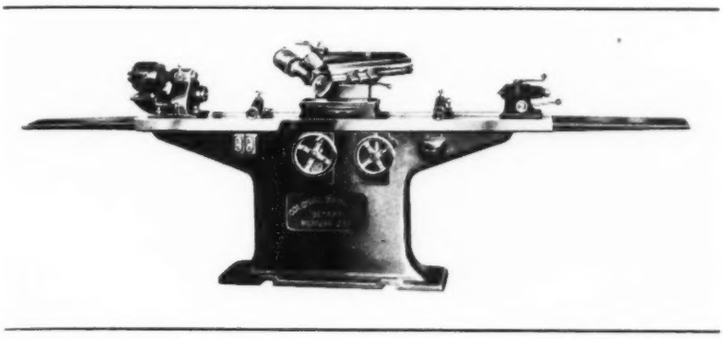


Colonial Sharpening Machine for Both Flat and Round Broaches

els on two roller chains which ride on hardened and ground ways in the head support. The head is also adjustable for side play and is so designed that a hydraulic feed can be provided for automatic operation. The entire slide mechanism is sealed against grinding dust.

Grinding wheels 5 inches in diameter, having a 1/2-inch face, are used for sharpening, while a 3-inch wheel is used for backing off. The grinding wheel spindle is driven direct by a motor running at 3600 revolutions per minute. Frequency changers permit spindle speeds up to 10,800 revolutions per minute.

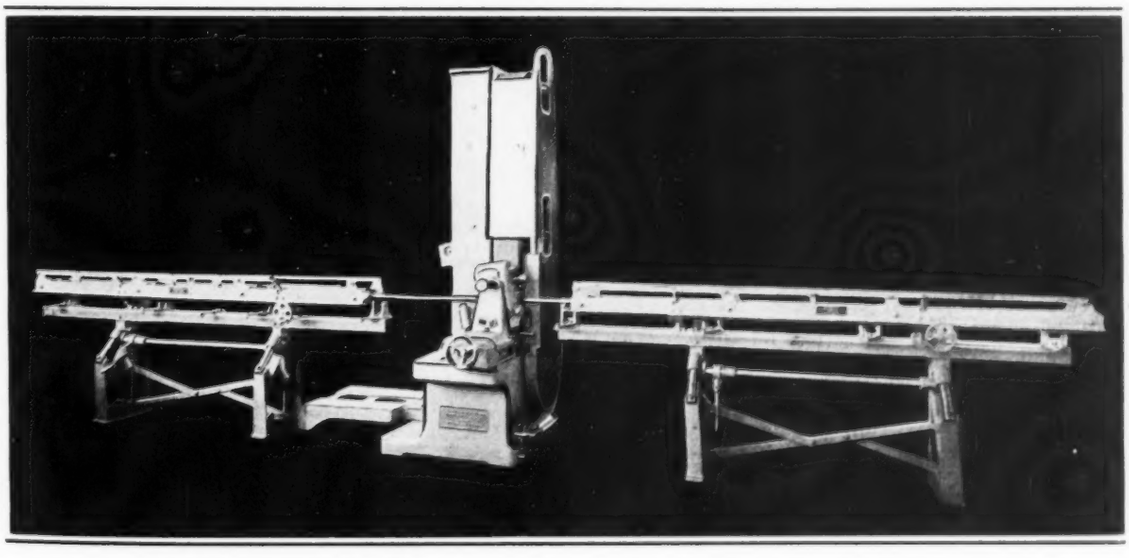
The table has a maximum travel of 60 inches. A headstock, tailstock, and steadyrests can be provided for grinding round and spline broaches, etc. Magnetic chucks can be supplied for holding flat broaches. 57

Adjustable Rod- and Tube-Holding Fixture for Polishing Machines

A polishing machine equipped on both sides with work-supporting and feeding fixtures having ball-bearing idler rolls is shown in the accompanying illustration. This fixture was designed by the Production Machine Co., Greenfield, Mass., for use in polishing long work in the Type A and No. 101 machines built by the concern. Each unit is approximately 8 feet long and will support lengths of work up to 14 feet. Weights up to 150 pounds can be handled, provided the work is fairly straight, and diameters from 1/2 inch to 6 inches.

Each fixture is equipped with twelve rolls arranged in three groups of four. The work rests on the lower group and there are two groups of side rolls and an upper group. The rear group of side rolls is fixed at the work-center height of the machine, and these rolls are not adjusted in changing over from one diameter of work to another. The rolls of the lower or supporting group, however, are adjusted along an incline of 45 degrees to take care of necessary vertical and horizontal movements. The front group of side rolls must be adjusted each time that the supporting roll group is moved. This adjustment is made by means of a handwheel, whereas the supporting roll group is adjusted through a lever.

The feed member on the polishing machine rotates the work, and the work, in turn, rotates the idler rolls. These rolls can be positioned at an angle to help feed the work. The rolls of each group are connected by a horizontal rod and can be swiveled equally by moving this rod. 58



Production Polishing Machine with New Work-supporting and Feeding Fixtures

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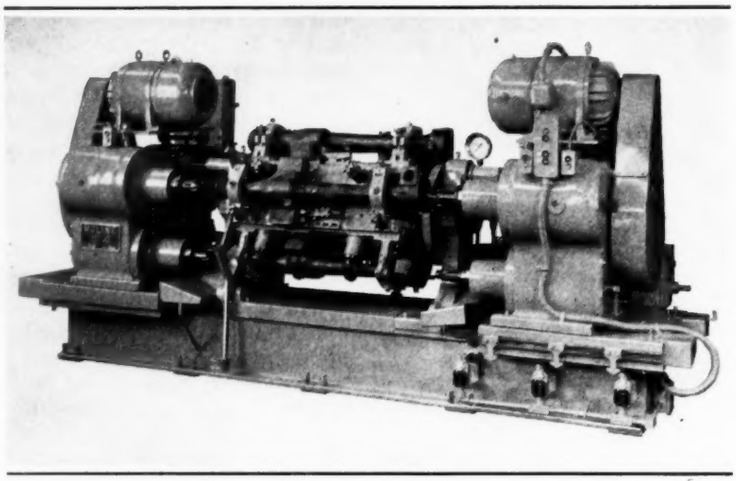


Moline Five-station Hydraulic-feed Boring and Drilling Machine

Moline Hydraulic-Feed Duplex Boring and Drilling Machine

A horizontal hydraulically fed duplex type of machine recently built by the Moline Tool Co., Moline, Ill., simultaneously rough-bores, semi-finish-bores, reams, counterbores, and drills both ends of tractor steering bolsters or pedestals to receive ball race seats. The base of this machine is equipped with removable hardened and ground steel ways on which the heads, which are provided with individual motor drive, are traversed horizontally. Each boring head has three spindles for the boring and reaming operations and one multiple-spindle head for drilling holes in the bolster flanges.

The feed cycle of the heads is automatically controlled by hydraulic units and includes a rapid traverse forward, a proper feed, an adjustable dwelling period against a positive stop, a rapid traverse return, and a neutral position. The length and position of the feed and the rapid traverse, the rate of feed, and the length of dwell can be quickly adjusted to meet the work requirements. The operator controls the various points in the feed cycle, as well as an emergency reverse, through a four-station push-button control.

The boring and drilling spindles are pulled into the work by means of piston-rods connected to the center of the spindle-carrying heads, with the result that the force is applied directly in line with the work; this eliminates stresses on the bed and excessive wear on the boring head bearings and on their hardened steel guide ways, thus insuring precise alignment. The multiple-spindle drill heads are complete units and can be quickly removed for substituting other heads. There is an end adjustment to compensate for wear of the drills.

The five-station drum fixture revolves on large-diameter ball bearings, mounted on a long double-ended hydraulic cylinder which provides the power for pulling the boring heads. This cylinder, in turn, is rigidly supported on brackets bolted to the bed. The top station of the drum is used for loading. The operator indexes the drum by stepping on a foot-pedal, the drum being accurately locked after each indexing by means of two plunger pins which operate with the horizontal movements of the boring heads. 59

Bardons & Oliver Cutting-Off Machine

Light- and heavy-wall tubing, pipe, and bar stock up to 5 3/4 inches in diameter can be cut off at a rapid production rate in an automatic cutting-off machine recently developed by Bardons & Oliver, Inc., Cleveland, Ohio. Two slides, one at the front and the other at the rear of the machine, are provided with tools that operate simultaneously, so as to reduce the cutting time to a min-

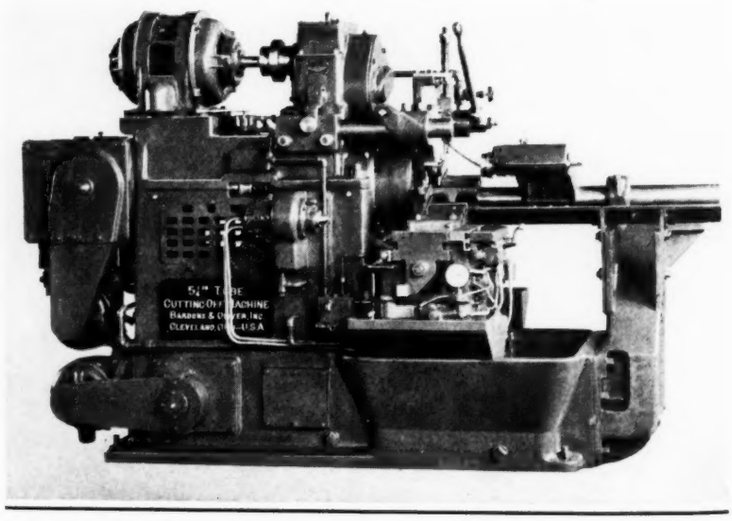


Fig. 1. Bardons & Oliver Cutting-off Machine with Hydraulically Actuated Tool-slides at Front and Rear

To obtain additional information on equipment described on this page, see lower part of page 396.

imum. When the work-pieces are not too long, multiple cuts can be taken and two or more pieces cut off at the same time.

Both tool-slides are hydraulically operated with a rapid approach, feed movement, and rapid return in their cycles. Two pumps are supplied. The pump that feeds the slides is geared directly to the spindle. The feed is adjustable by simply turning a graduated dial on the pump, through which feeds in increments of 0.0001 inch can be obtained. The second pump, which is driven by a separate constant-speed motor, actuates the rapid traverse.

A hydraulic valve automatically controls the movements of the two slides. This valve is actuated by adjustable trip-dogs when the machine is operated automatically, but it can be actuated manually. Manual operation is desirable on short runs and when cutting off scrap ends of pipe. Two spindle speeds are obtainable through a lever on the front of the machine, a wide range of speeds being available through change-gears.

For cutting off solid bars, an accelerating arrangement can be provided, by means of which the spindle speed is increased as the diameter of the bar is reduced, thereby maintaining a uniform surface speed. This is accomplished through the use of a variable-speed motor.

The master collet is of a hinged type and is air-operated. It automatically compensates for slight variations in stock dimensions, and large variations can be provided for by making a manual adjustment. False jaws to accommodate different diameters are easily interchanged without removing the collet from the spindle.

There is no limit to the length of stock that can be fed out by the patented roller-bar feed. This feed is driven by a separate motor, so as to maintain a constant feeding rate, regardless of the spindle speed. The feed can be reversed electrically when it is necessary to back stock out of the spindle. The rollers can be spread apart when the collet is open, a feature that is especially advantageous in starting a bar with a flared and ragged end through the feed. The stock stop is air-operated. 60

H-P-M Self-Contained Injection Molding Press

An injection molding press for the synthetic plastic industry is being placed on the market by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, that embodies a number of improvements over the press introduced by the concern about three years ago. This Model 25 injection molding press can be operated either automatically, semi-automatically, or manually. In full-automatic control, the cycle is started through a limit switch engaged by the return movement of the clamp ram. In semi-automatic operation, the operator must use both hands to depress dual starter buttons, thus insuring that both hands will be clear of the die. Manual operation is controlled through two pilot valves.

The molds are closed by hydraulic power operating directly on the clamp cylinder, an arrangement that shows at all times what bearing pressures are being developed. There are two hydraulic members, the molding clamp member which has a horizontal hydraulic cylinder and a double-acting ram with moving and floating die-carrying platens, and a plastic extrusion member which also has a horizontal hydraulic cylinder and a double-acting ram for actuating the extrusion plunger.

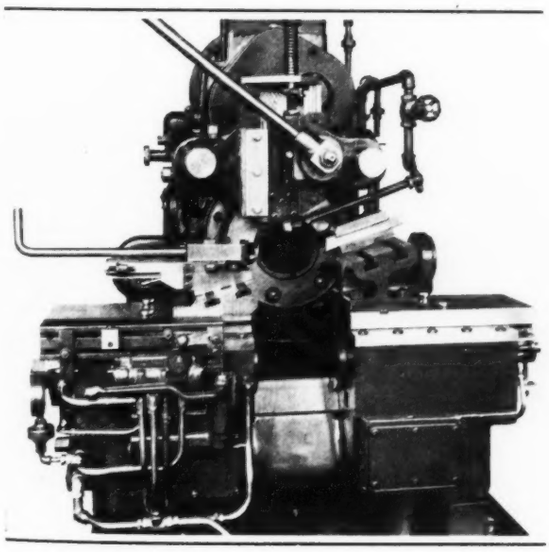
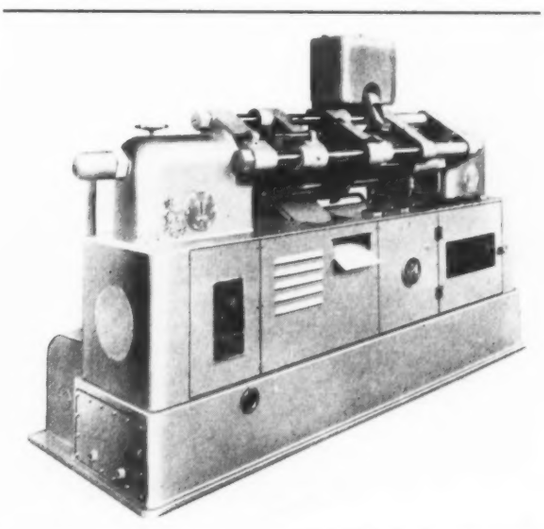


Fig. 2. End View of Cutting-off Machine, Showing Arrangement of Tool-slides



H-P-M Hydraulic Injection Molding Press for Synthetic Plastics

To obtain additional information on equipment described on this page, see lower part of page 396.

The functions performed by this machine include (1) clamping the mold halves under direct hydraulic pressure; (2) feeding the material in measured quantities; (3) heating the material to plasticity; (4) contacting the plastic material chamber outlet with the mold inlet; (5) extruding the plastic material from the heating chamber under intensified hydraulic pressures into the mold cavities, where the plastic material chills and sets; (6) opening the mold; and (7) ejecting the finished article.

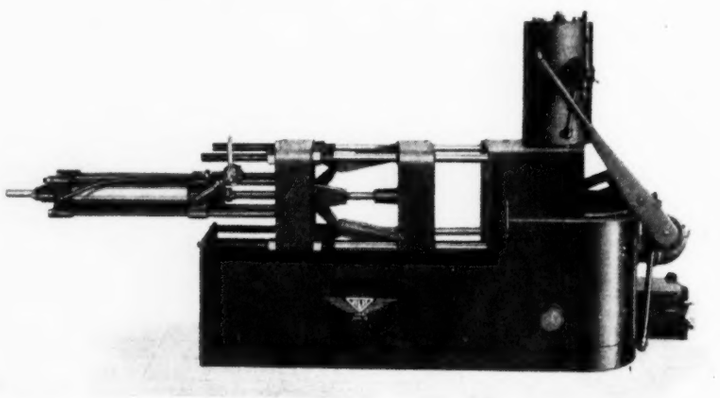
The thermo-plastic material is heated by circulating oil through a channel around the material. The oil is heated electrically, and its temperature is accurately controlled by a thermostat. 61

Harvill High-Speed Die-Casting Machines

Fully pneumatic die-casting machines of high-pressure injection types are being placed on the market in three sizes by H. L. Harvill, Inc., 2344 E. 38th St., Los Angeles, Calif. The No. 4 machine, which is the smallest of the line, accommodates die-plates measuring 9 1/2 by 11 3/4 inches. This machine is available in a style that is manually operated, a second style in which some of the machine movements are automatic, and a third style in which most of the machine movements are automatic. The maximum die space is 14 inches. This machine is intended for the small-lot production of small-size parts; it has a stroke of 6 1/4 inches, and can be operated up to 500 times an hour.

The No. 5 machine, here illustrated, is intended for general all-around use. It has a capacity for producing castings up to 15 pounds in weight and can be supplied with die-plates measuring 16 by 18 inches, the maximum die space being 20 inches. This machine has a stroke of 10 1/4 inches, and can be operated about 400 times an hour.

The No. 6 machine is of the same design as the No. 5, but it is much heavier and accommodates die-plates measuring 21 by 23 inches. The maximum die space of this machine is 22 inches. The stroke is 14 inches, and up to 300 "shots" can be made per hour. 62



Harvill Pneumatically Operated Die-casting Machine

Leitz Simplified Profile Projector

A Leitz projector intended for inspecting gears, templets, gages, taps, screws, watch parts, etc., in the average tool and instrument shop, has just been placed on the market by the George Scherr Co., 124 Lafayette St., New York City. Parts to be inspected are placed on top of a compound table which has a micrometer adjustment of 1 inch in both directions.

Leitz Projector, Marketed by the George Scherr Co.

The contour of the part can be magnified from 10 to 100 times, and even up to 200 times in special instances. It is projected on a drawing-board directly in front of the instrument, the operator comparing the outlines of the part with a drawing made to scale. Deviations from the standard can be accurately measured by the two micrometer screws of the cross-table or by gage-blocks.

The upright construction of the instrument conserves space and enables small parts to be inspected without the necessity of clamping them in fixtures or vises. Cylindrical parts, such as taps, thread gages, cutters, or hobs can be held between centers for checking the form, lead, angle, and concentricity. The table can be swiveled in both directions to obtain a sharp image of both flanks of screw threads having a helix angle up to 12 degrees.

The light source is a low-voltage incandescent lamp which may be connected directly to a circuit of 110 or 120 volts by using the rheostat supplied. When the apparatus is not in use, the drawing-board can be pushed into the base to protect the drawing and save space. 63

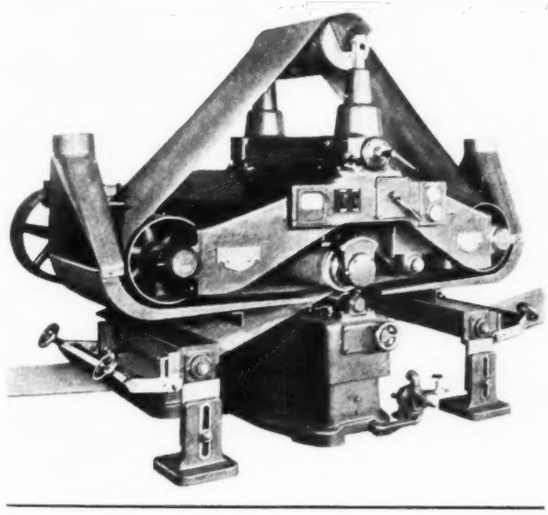
To obtain additional information on equipment described on this page, see lower part of page 396.

Mattison Continuous-Strip Grinder

Coils of strip stock are ground by factory-coated abrasive belts in the continuous grinding machine here illustrated, which was recently brought out by the Mattison Machine Works, Rockford, Ill. This machine is intended for such use as the grinding of hot-rolled coils after pickling, annealing, and reducing, so as to remove any imperfections. It can also be applied after each additional cold reducing operation.

This machine is constructed with power-driven reels at each end, from which the strip passes guiding rolls and over a work-support roll. The work-support roll has a quick air-actuated movement for disengaging the work from the belt. Ample movement provides room for passing the strip under the belt while loading.

The grinding roll is cushioned, and there is an adjustment for regulating the grinding tension. The belt is driven from both ends and can be run in either direction. Flexing of the strip as it passes over the support roll and the point contact of the grinding roll provide for a fast cutting belt action and duplicate the action of wide-belt grinders used for wide sheets. This machine is built in several sizes for grinding strip 12, 18, 24, and 36 inches in width. 64

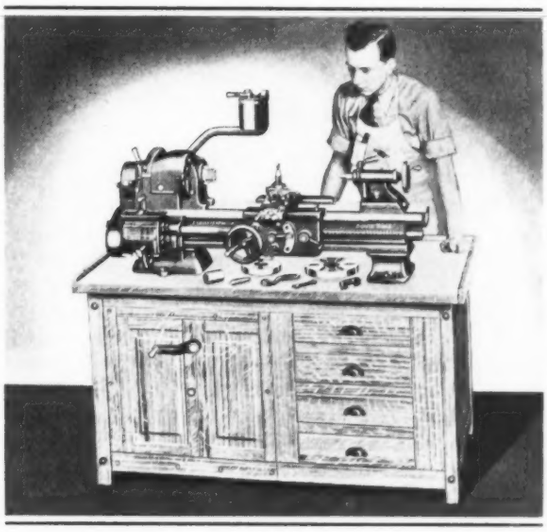


Mattison Abrasive-belt Grinder for Coiled Strip Stock

Lufkin Master Planer Gage

A master planer and shaper gage that facilitates making adjustments for depth of first and succeeding cuts has been added to the line of products manufactured by the Lufkin Rule Co., Saginaw, Mich. The desired depth of cut is obtained by setting a slide that moves on an inclined plane, through the use of a micrometer, a surface gage, or caliper, and then bringing the tool into contact with the gage.

Tool settings from 1/4 inch to 9 inches in height can be made with an extension, and tool settings from 1/4 inch to 6 1/2 inches without the extension. The gage also serves as an adjustable parallel, and it can be employed with a sine bar for grinding to angles or with gage-blocks in building up work on a surface plate. It can be used with an indicator for transferring measurements. The gage can be used on its base, end, or sides. 65



South Bend 9-inch Lathe with 1 3/8-inch Hole through the Spindle

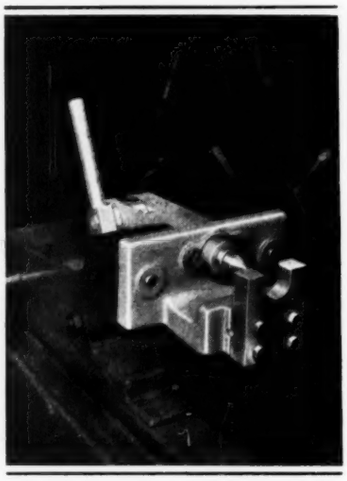
South Bend 1-Inch Collet Lathe

A lathe of 9 inches swing with a 1 3/8-inch hole extending through the spindle and a collet capacity of 1 inch has been announced by the South Bend Lathe Works, 720 E. Madison St., South Bend, Ind. This new lathe is of the back-geared screw-cutting type and is adapted especially for manufacturing departments and tool-rooms.

All regular attachments are available. The draw-in collet chuck attachment can be supplied in both handwheel and quick-acting lever types. A six-tool turret and a double tool-slide can be furnished to adapt the lathe to handling multiple-operation manufacturing jobs. A telescopic taper attachment, an electric grinder, and milling and keyway-cutting attachments are available.

This lathe is manufactured in several types, including an underneath-belt motor-driven type, a tool-room lathe, a horizontal adjustable motor-driven bench lathe, and a countershaft-driven lathe. A two-speed motor drive provides twelve spindle speeds from 50 to 400 revolutions per minute. 66

To obtain additional information on equipment described on this page, see lower part of page 396.



Landis Work-holding Equipment

Special Work-Holding Equipment for Landmaco Threading Machines

Special work-holding equipment was recently designed by the Landis Machine Co., Inc., Waynesboro, Pa., for accurately locating and holding an automotive part in a Landmaco threading machine in such a way as to insure concentricity between the thread and other surfaces of the work. The equipment includes a special traveling center located in the bore of the head for supporting the front end of the work. This center eliminates any possibility of the chasers leading off center. A long heavy spring, also in the bore of the die-head spindle, keeps the center against the work with a constant pressure.

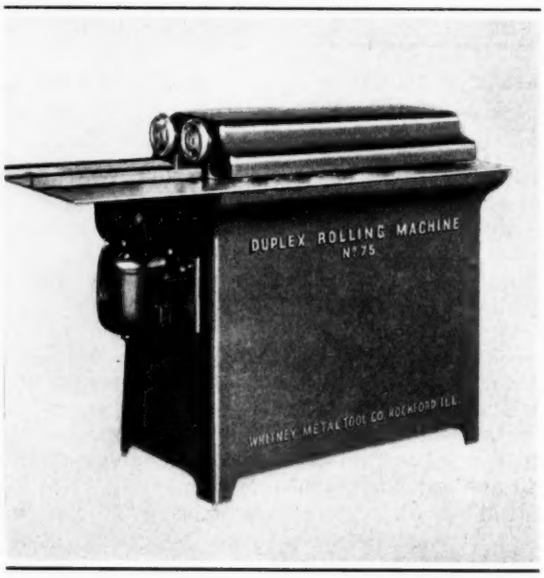
A second center located on the carriage, which may be seen in the illustration directly in back of a steel block that is cut out to conform with the shape of the work, supports the opposite end of the work and also provides a locking action. This second center is held in a short spindle, the opposite end of which operates against a cam mounted on a shaft at right angles to the spindle. One end of this shaft is milled to a hexagon and is fitted with a short handle.

In operation, the work is first located on the traveling center and then dropped into the steel block on the carriage. The cam handle is then pushed forward to bring the locking center against the work and to push it forward until a shoulder on the work rests against the back surface of the driving block. Since the cam imparts a slow movement to the center spindle, a positive locking action is obtained the instant that the work strikes the driving block. The locking center can be adjusted both horizontally and vertically to maintain alignment with the center of die-head rotation. ... 67

Whitney-Jensen Sheet-Metal Rolling Machine

A machine with a double set of rolls has recently been developed by the Whitney Metal Tool Co., Rockford, Ill., for use primarily in sheet-metal fabricating shops that make air-conditioning and ventilating ducts or similar products having folded seams like the Pittsburgh or hammer lock. With the double set of rolls, one set can be used for forming corner locks and the other for drive cleats, etc. Also, both sets can be used at one time, so that no change-over of the machine is required for handling different types of work.

This machine will handle material up to No. 18 gage at a speed of 36 feet per minute. The rolls are adjustable to suit the thickness of the metal being formed by means of a handwheel equipped with a micrometer scale. The extension feed table has guide bars that can be adjusted to regulate the amount of overhang in forming corner locks. ... 68



Whitney-Jensen Sheet-metal Rolling Machine with Double Set of Rolls

Electrodes Added to the Murex Line

Two new electrodes for manual arc welding are announced by the Metal & Thermit Corporation, 120 Broadway, New York City, exclusive sales agent for the American Murex Corporation. One electrode, which has been termed Murex Vertex, is a reverse polarity rod intended for welding mild steel in flat, vertical, and overhead positions. It is especially suitable for general shop work in cases where positioning of parts for welding is not practical, and also in ship, bridge, and building construction. This electrode has a yield point ranging from 49,000 to 55,000 pounds per square inch and an ultimate tensile strength of 65,000 to 72,000 pounds per square inch.

The second electrode, which is known as Murex Genex, can be used in all positions, and readily bridges gaps between plates that have been caused by poor assembly fits.

To obtain additional information on equipment described on this page, see lower part of page 396.

This is a straight polarity electrode. It has a yield point of 55,000 to 60,000 pounds per square inch and an ultimate strength of 70,000 to 75,000 pounds per square inch. 69

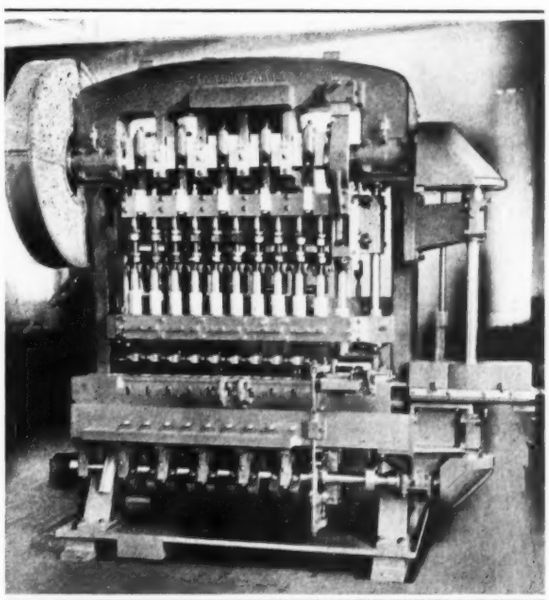
Waterbury Farrel Crank-Type Eyelet Machines

A series of crank type eyelet machines or multiple-plunger presses has been developed by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., to supplement the line of cam-operated eyelet machines that have long been built by the concern. The new machines are designed to handle heavier gages of metal than the cam-operated machines, including steel. They are built in three sizes, the largest of which is shown in the illustration.

These crank type machines are usually furnished with seven, nine, or eleven plungers. A rear roll feed pulls the metal through the machine from a coil-holder or floor reel in front, and there is a finger motion for use in cutting a second or third row of eyelets from the coiled stock.

After the blank has been cut, it is automatically carried to the second or cupping station which is provided with a blank-holder. Here the cup is knocked out of the die and lifted into a transfer slide having snap fingers that carry the cup to the third and successive stations used for drawing and forming operations.

Power for performing the work is applied through cranks to a slide that moves vertically. Different features adapt the machines to comparatively heavy forming and deep drawing. The machines can be operated up to fifty strokes a minute when the stock is ordinary brass. In single-row operations, stock up to 3 7/8 inches wide can be handled, and in double-row operations, up to 7 1/4 inches wide. The maximum blank size is 0.032 inch thick by 3 3/4 inches in diameter, or 0.125 inch thick by 1 inch in diameter. The maximum drawing depth with the standard 7 1/2-inch stroke is 2 1/8 inches. 70

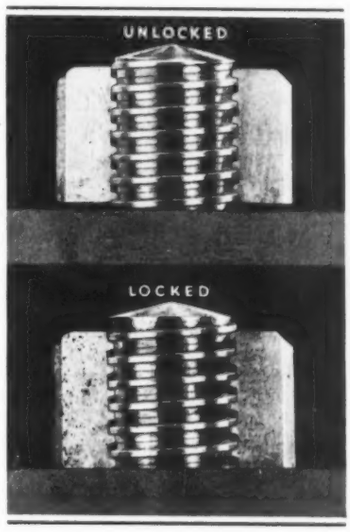


Crank Type of Eyelet Machine, Made by the Waterbury Farrel Foundry & Machine Co.

Dardelet Improved Self-Locking Screw Thread

A self-locking screw thread profile with improved features has been patented by the Dardelet Threadlock Corporation, 55 Liberty St., New York City. This new thread, which is known as the "Dardelet relieved profile," has the advantages of a free spinning nut, rapid development of the bolt tension, and gradually increasing locking action. There is an increased range of thread tolerances for manufacturing purposes.

The illustrations show bolt and nut threads in the unlocked and locked positions. The root of the bolt thread is stepped at the middle point. Each step is tapered



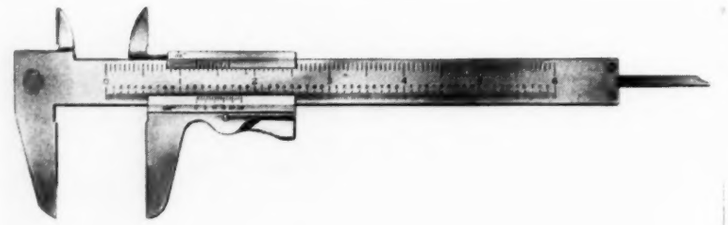
Relation of Dardelet Screw Threads in Unlocked and Locked Positions

6 degrees in relation to the axis of the screw. The lower step is under-cut from 0.003 to 0.005 inch, depending upon the nominal diameter of the thread, in contrast to the original Dardelet thread which has a continuous tapered slope on the root of the bolt thread without any step.

Clearance exists between the assembled bolt and nut threads, as seen in the upper view of the illustration, when the thread is unlocked. This permits a limited axial displacement in the relative thread positions from unlocked to locked.

When a wrench is applied to the nut after it has been freely spun against the work, a bolt tension or pull is immediately produced, because the clearance provided by the relief permits only a line contact on the locking surfaces of both the bolt and nut threads at this stage of assembly. Continued application of the wrench increases the bolt stress sufficiently to change the position of the nut thread relative to the bolt thread, and thus

To obtain additional information on equipment described on this page, see lower part of page 396.



Mauser Universal Vernier Caliper Made Entirely of Stainless Steel

Mauser Vernier Caliper of Stainless Steel

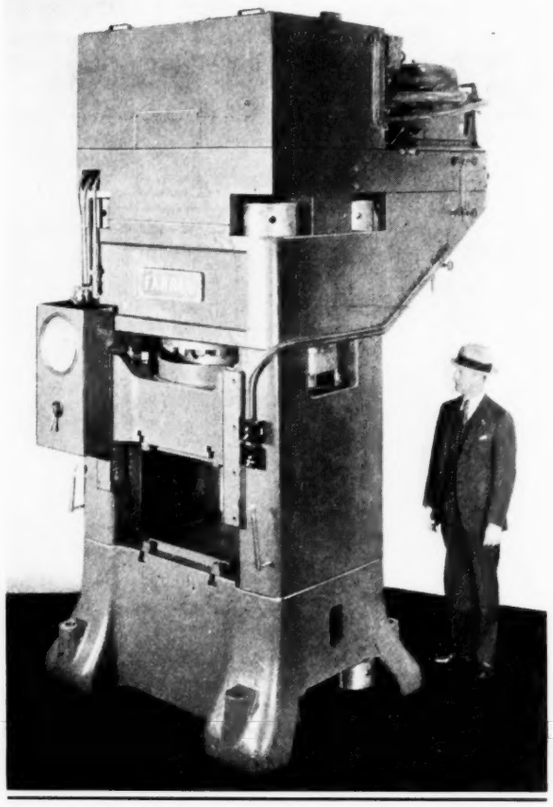
A universal vernier caliper made entirely of stainless steel has been added to the Mauser line handled by the George Scherr Co., 124 Lafayette St., New York City. This instrument, which was previously available only in chromium steel, has been brought out in stainless steel to obviate stains and tarnish when used in damp atmospheres and in shops where it may be exposed to acid. The measuring surfaces of the new caliper have a hardness of not less than 55 Rockwell C., which provides for long life. 73

gradually forces the nut thread upward along the tapered slope of the bolt thread. Thus the locking action is built up by gradually increasing the area of the locking surfaces in contact and at the same time increasing the bolt tension. 71

Farrel Hydraulic Molding Press

The hydraulic press here illustrated was recently built by the Farrel-Birmingham Co., Inc., Ansonia, Conn., for molding automotive-brake blocks. This press is self-contained, being equipped with a motor-driven pump. It has a maximum capacity of 500 tons with one down-acting 21-inch diameter ram and two double-acting cylinders of 6 1/8 inches diameter. The initial pressure is 2600 pounds per square inch.

The control panel provides infinite pressure regulation over a range of from 10 to 500 tons. Any ten pressures in this range can be set for immediate selection. The dwell of the pressure on the work can be timed at from 2 to 40 seconds by means of an automatic device. An automatic working cycle is effected through a push-button control. The press has a maximum opening of 24 inches, a maximum stroke of 24 inches, and a platen area of 38 by 31 inches. Both the bottom and the moving cross-heads are provided with T-slots for attaching molds. 72



Hydraulic Molding Press Recently Built by the Farrel-Birmingham Co.

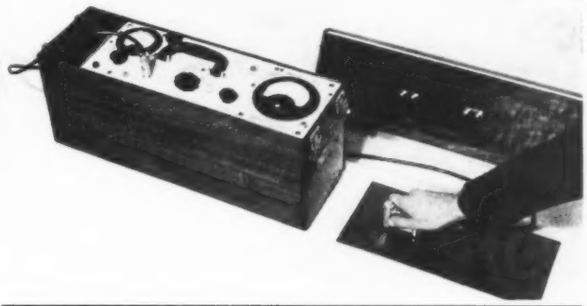
Micro Interchangeable Precision Limit Switch

The Micro Switch Corporation, 3 E. Spring St., Freeport, Ill., has recently developed a compact limit switch, the snap point location of which is held in close relation to dowel holes in the mounting plate. This often eliminates the necessity of having the actuating parts adjustable and enables the switches to be replaced without readjustment. The standard Micro switch is contained in a steel case, sealed against the entrance of oil and water.

The switch is actuated by a plunger having a total travel of 1/4 inch, although the operation is effected by a movement of only 0.001 inch at the beginning of the plunger travel. The exact point of plunger travel at which the switch is actuated is said to be well maintained over millions of operations, even though the plunger is operated by hammer blows or allowed to snap off a cam.

To obtain additional information on equipment described on this page, see lower part of page 396.

Interchangeable Precision Limit Switch Made by the Micro Switch Corporation



Profilometer—an Instrument that Gives Direct Readings of Surface Finish

The small size of this unit, 2 3/4 inches by 1 9/16 inches by 15/16 inch, adapts it to application on automatic machine tools or other machinery in which precise limits of motion are required. 74

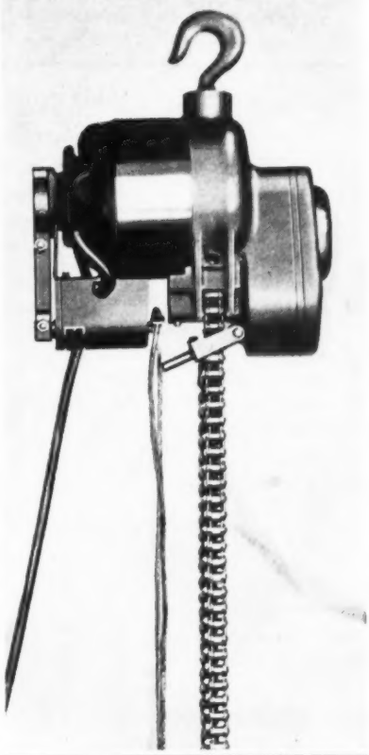
Profilometer—An Instrument for Checking Surface Finish

An instrument that determines the quality of the finish on metal surfaces by actually measuring the roughness of the surface has been made available for shop use by the Physicists Research Co., 337 S. Main St., Ann Arbor, Mich. This instrument is intended especially for determining the quality of surfaces machined by grinding, honing, lapping, etc. It can be applied to flat, cylindrical, or curved surfaces of a wide variety of sizes and shapes. The instrument does not scratch or otherwise damage finely finished work.

This instrument consists of a tracer unit which is held in the hand and a box containing a meter that is calibrated directly in micro-inches (1 micro-inch equals 0.000001 inch). Readings are taken directly from this meter as the tracer unit is moved across the surface being inspected. The meter gives a continuous running average of the height of surface irregularities.

The tracer can be moved either manually or mechanically. For most work, a movement at the rate of about 1 inch per second has been found convenient. The details of the tracer can be modified somewhat, depending upon the type of surface to be measured. The instrument box can be arranged for portable use or for mounting on a panel.

On most surfaces, the irregularities that constitute roughness are only a few thousandths of an inch wide, and so the instrument is designed to measure irregularities whose widths do not exceed about 1/32 inch. The sensitivity of the instrument can be adjusted by means of a selector switch to give a full-scale reading of 3, 10, 30, 100, 300, or 1000 micro-inches. The overall dimensions of the equipment are 7 by 10 by 22 inches and the weight about 50 pounds, although if a sensitivity of 10 micro-inches, full scale, is sufficient, the instrument can be reduced appreciably in dimensions and weight. 75



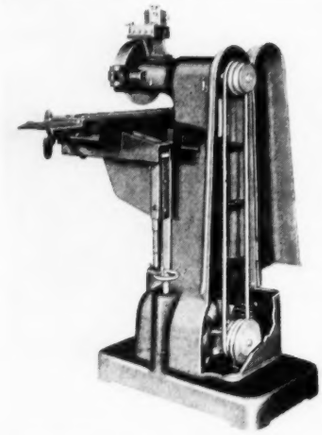
Electric Hoist of 500 Pounds Capacity which Weighs 58 Pounds

Shaw-Box Light-Weight Portable Electric Hoist

A portable electric hoist of 500 pounds lifting capacity, which weighs only 58 pounds, has been placed on the market by the Shaw-Box Crane & Hoist Division, Manning, Maxwell & Moore, Inc., Muskegon, Mich. This "Budgit" hoist is believed to be the first electric hoist weighing less than a hand-operated spur-geared chain hoist of equal capacity. It operates from lighting sockets.

This hoist is regularly supplied with sufficient chain to give a lift of 10 feet, but additional lift is obtainable by lengthening the chain. The distance between the upper hook and the load hook, when the latter is in its highest position, is only 16 inches. With a 500-pound load, the lifting speed is 17 feet per minute. Needle type roller bearings are provided at all bearing points. 76

To obtain additional information on equipment described on this page, see lower part of page 396.



Covel Surface Grinder of Hand Feed Type

Covel Hand-Feed Surface Grinder

The Covel Mfg. Co., Benton Harbor, Mich., has recently brought out a hand-feed surface grinder intended both for short-run production and tool-room jobs. Changes from one run of work to another can be easily made, and the operator can feed the table fast or slow at will, depending upon the work finish required. The work-table is moved up to the grinding wheel, the wheel-spindle revolving in a fixed location.

This machine is recommended by the manufacturer for a work accuracy within one ten-thousandth inch. The spindle is mounted in special precision ball bearings preloaded to 300 pounds, and is equipped with a three-speed V-belt drive. Speed changes are quickly made through the door at the back of the column. This easy accessibility saves time in changing spindle speeds to compensate for wear of the grinding wheel.

Power is provided by a 1 1/2-horsepower motor mounted on a hinged plate and separated from the base of the column by means of vibration dampers. The belt tension is controlled by adjusting the motor position through a handwheel at the right of the column.

The machine has a table working surface of 6 by 18 inches, a longitudinal table travel of 19 1/2 inches, a transverse travel of 7 1/2 inches, and a vertical travel of 11 inches. The maximum capacity under a 10-inch wheel is 10 inches. 77

Semco Utility Corner-Notching Dies

A full line of corner-notching dies has been added to the products of the Service Machine Co., 162 Miller St., Elizabeth, N. J., for use in the jobbing shops of the sheet-metal industry. These

Sheet-metal Corner-notching Die Made by Service Machine Co.

dies are especially designed for quick set-up and easy gaging, the latter being facilitated on 7- and 10-inch sizes by direct-reading scales.

The blades are supplied with an included angle of either 45 or 90 degrees. The 45-degree sets are made with 7- or 10-inch blades, and the 90-degree sets with 2 1/4-, 5-, 7-, or 10-inch blades. Four sets of gages are furnished with the 5-, 7-, and 10-inch dies. They are keyed in the slots for accurate setting.

In addition to corner-notching, these dies are suitable for the occasional cutting off of strips and narrow sheets. With the exception of the smallest set, the dies will handle sheets up to 0.140 inch thick and strips up to 3/16 inch thick. Larger sizes of these die sets can be made special to meet requirements. 78

Hammond Overhanging-Spindle Grinder

A grinding machine of overhanging-spindle design that provides for the convenient handling of large bulky work has been brought out by the Hammond Machinery Builders, Inc., Kalamazoo, Mich. The top section of this grinder overhangs 12 1/2 inches from the lower front of the base. The distance between the grinding wheels is 40 3/8 inches, and the spindle is 52 inches long over all.

This Model ROG grinder is equipped with 14-inch diameter guards. The standard equipment includes push-button control switches with an automatic motor starter provided with thermal overload protection. Motors up to 7 1/2 horsepower can be fitted inside the base. The net weight of the machine is 1200 pounds.

Although the grinder is shown in the illustration without work-rests, which generally are not required with large bulky work, they can be supplied, if desired. 79

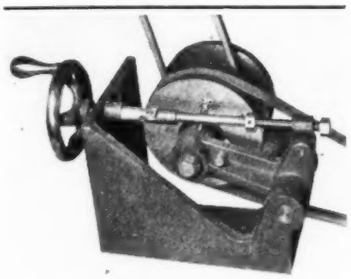
Hammond ROG Grinder with Overhanging Spindle

To obtain additional information on equipment described on this page, see lower part of page 396.

Single Unit Speedmaster of 6 to 1 Ratio

A single-unit transmission that gives an infinite range of speeds within a ratio of 6 to 1 has been placed on the market by the Speedmaster Division of the Continental Machine Specialties, Inc., 1301 S. Washington Ave., Minneapolis, Minn. This unit is a companion to the Speedmaster described in December, 1937, MACHINERY, page 284, which gives a 40 to 1 variation.

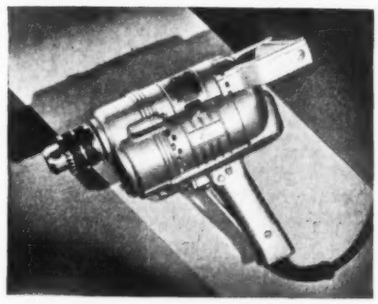
The new smaller unit is completely self-contained and is suitable for installation between a motor and the driven machine. Speeds are changed through a handwheel. The unit is equipped with Bakelite pulleys which insure long belt life and eliminate static electricity. It can be used for fractional-horsepower installations and for other drives up to 5 horsepower. 80



Speedmaster Having Infinite Speed Range within a 6 to 1 Ratio

Half-Inch Portable Electric Drill Weighing Only 9 Pounds

The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has brought out a Thor 1/2-inch portable electric drill which weighs only 9 pounds and is but 12 inches long over all, this weight and length being about one-half similar specifications for previous drills of the same capacity. The drill is designed for either continuous service in production lines or for maintenance work. Its streamline design permits the tool to be used in close quarters.



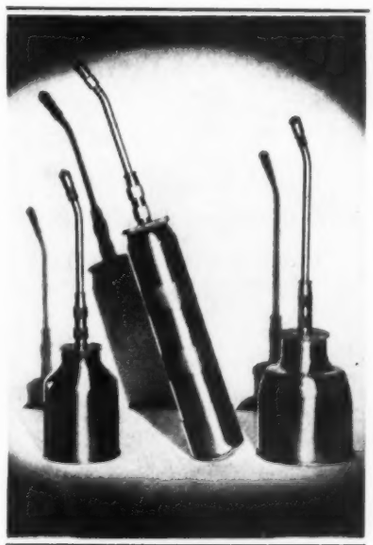
Thor Half-inch Drill Weighing Only Nine Pounds

The drill can be quickly converted into a sensitive drilling machine by mounting on a stand. The universal motor has a free speed of 450 revolutions per minute and a full-load speed of 300 revolutions per minute. 81

Acco-Morrow Pressure Lubricators

Lubricant at pressures up to 1000 pounds per square inch can be supplied to bearings, gears, or other moving parts of machinery through the use of Acco-Morrow pressure lubricators, recently introduced on the market by the American Chain & Cable Co., Inc., York, Pa. At such pressures, the lubricant flushes out all grit and dirt from a machine bearing at the same time that oil is forced into the bearings.

The composition "Oilingseal" tip makes a pressure-tight contact on the top edge of any common oil-hole and of practically all sizes and types of cups and oil-hole covers in general use. No special fittings are required. The illustration shows three types of lubricators included in this line. 82



Several Types of Acco-Morrow Pressure Lubricators

Limit Switch with Small Alnico Magnet

Alnico Snap-Action Limit Switch

An Alnico snap-action limit switch well suited to machinery requiring a compact heavy-duty reversing switch for opening or closing a control circuit under conditions where accuracy of operation is of primary importance has been developed by the General Electric Co., Schenectady, N. Y. This switch is particularly advantageous for tapping, threading, grinding, and other machines having reciprocating members.

The switch is of single-pole, double-throw design, and is equipped with silver-faced tips on both the moving and stationary contacts to insure reliable operation and long life. Protection from oil is afforded by a steel case having gaskets on two sides and an opening in the rear for conduit connections.

The movable-contact assembly

To obtain additional information on equipment described on this page, see lower part of page 396.

is held firmly in position by a small Alnico magnet which acts on an iron yoke. As soon as this yoke is broken away from the magnet face by direct mechanical action of the operating lever, a spring snaps the contact assembly to the opposite position, where it is held by the magnet until the yoke is again broken away. The operating point is thus determined entirely by the position of the lever, and is independent of the tension in the spring. 83

Adapter Plates for Brown & Sharpe Permanent-Magnet Chucks

Adapter plates designed to be used with magnetic chucks of the permanent magnet type for holding small pieces that cannot be held readily on the regular surfaces of these chucks are being introduced to the trade by the Brown & Sharpe Mfg. Co., Providence, R. I. These adapter plates are made with narrow steel strips or bars alternating with non-magnetic brass spacing strips.

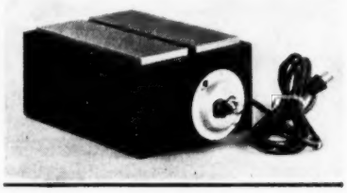
The magnetic flux from the chuck is conducted through the comparatively narrow steel strips. Each of the magnetic flux circuits is separated by a narrow brass spacing strip only, so that correspondingly small pieces can be held securely over the entire surface of the adapter plate.

These adapter plates are available in two sizes—7 9/32 inches long by 3 inches wide and 7 1/2 inches long by 3 3/4 inches wide. Work as small as 5/16 inch long by 1/16 inch wide can be held on the plates. 84

Vitavox Demagnetizer

A demagnetizer of the design illustrated is now being manufactured for the market by the Vitavox Co., 430 S. Green St., Chicago, Ill., after having been used for some time in the tool-room of the concern. This demagnetizer is of the transformer type and draws 10 amperes of electrical current, which is sufficient for demagnetizing deep-drawing and blanking dies up to 5 inches thick.

The work to be demagnetized is simply placed on the pole pieces and a switch turned on. After a few seconds, the work is raised slowly from the demagnetizer a distance of several feet and the switch turned off.

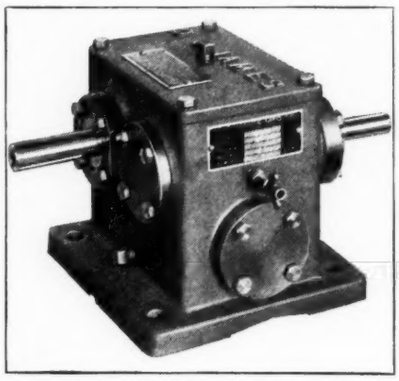


Demagnetizer of Transformer Type Built by the Vitavox Co.

The device is designed for operation on 110-volt alternating current of 60 cycles. It measures 11 by 8 3/4 by 5 1/2 inches and weighs 55 pounds. 85

D. O. James Double Worm-Gear Reducers

Double worm-gear reducers of the design here illustrated are being produced in three new sizes by the D. O. James Mfg. Co., 1120 W. Monroe St., Chicago, Ill. These reducers are available in a wide range of speed ratios from 30 to 1 up to 3600 to 1. The torque capacity of the slow-speed shaft is from 40 to 400 inch-pounds.



D. O. James Reducer with Two Sets of Worm-gearing

These reducers are made with two bronze worm-gears and two steel worms mounted in Timken tapered roller bearings within a small space, giving a light drive with high ratios. 86

Crobalt for Wear-Resisting Applications

The Michigan Tool Co., Detroit, Mich., announces that Crobalt, which has been used for several years as a cutting metal, is now available for wear-resisting applications as well. Crobalt is a cast metal consisting mainly of cobalt, chromium, and tungsten. It can be welded or brazed to soft or hard steel and is highly resistant to heat, abrasion, and corrosion (including acid).

Adapter Plates for Holding Small Parts on Permanent-magnet Chucks

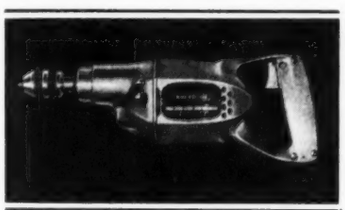
Center Made by the Michigan Tool Co. with a Crobalt Tip

To obtain additional information on equipment described on this page, see lower part of page 396.

The relatively low cost of Crobalt makes it economical to produce many small parts entirely of this metal for wear-resisting purposes, this practice often being less expensive even than brazing and welding Crobalt strips to steel. The concern mentioned recommends the use of Crobalt for such parts as boring-bar pads, locating pins, lathe centers, chuck jaws, steadyrests, gages of various types, drill and reamer guides, etc. 87

Black & Decker Low-Speed Ball-Bearing Portable Electric Drill

A portable electric drill adapted for drilling stainless steel, Monel metal, and other hard metals has



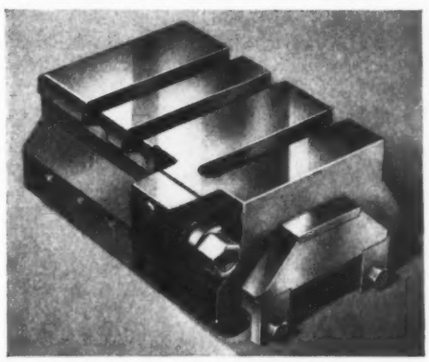
Black & Decker Quarter-inch Portable Electric Drill for Hard Metals

been brought out by the Black & Decker Mfg. Co., 735 Pennsylvania Ave., Towson, Md. This tool has a capacity for drilling up to 1/4 inch in steel and up to 1/2 inch in hard wood. It has a standard no-load speed of 450 revolutions per minute, and a full-load speed of 285 revolutions per minute. The net weight is 6 1/4 pounds, and the over-all length 13 inches. The drill is regularly supplied for 110-volt current, but it is also available for current of 32, 220, or 250 volts. The universal motor drives the spindle through a triple-reduction gear train. The armature and spindle are mounted in ball bearings. The Portomatic keyless chuck and patented gear locking pin expedite the changing of drill bits. 88

Slide for Automatic Screw Machines

A new type of slide for application to Gridley automatic screw machines of any size is now a standard product of the Modern Collet & Machine Co., Ecorse, Mich. This slide is designed to eliminate all rocking or swaying, regardless of the cuts taken by the tools mounted on it. The bearing surface of the slide is about three times the bearing surface ordinarily provided.

Adjustments can be easily made and settings are securely held. The slide can be quickly installed. 89



New Type of Slide for Automatic Screw Machines

Carboloy Cemented-Carbide Tap

The Carboloy Company, Inc., 2987 E. Jefferson Ave., Detroit, Mich., is introducing on the market a tap of solid Carboloy cemented carbide intended primarily for use on unfired porcelain. This tap is 0.153 inch in diameter and is made with thirty-six full-vee threads per inch, the over-all length of the tap being 1 3/4 inches.

A similar tap now in service has tapped 70,000 holes with one sharpening and has an estimated life of 280,000 holes. High-speed steel taps that were previously used on the same job gave only 250 holes per grind, or a total of 1000 holes per tap. Experience with these Carboloy taps has thus far been confined to such materials as Bakelite, unfired porcelain, hard rubber, etc. 90

Heavier Twelve-Point Box "Superrenches"

J. H. Williams & Co., 61 Spring St., New York City, announce the addition of three new double-head, double-offset twelve-point box "Superrenches" to their line of wrenches. These new wrenches are designed for heavy service. They range in length from 23 to 27 inches and have openings from 1 7/16 to 2 3/8 inches. They are intended for use in unusually close quarters, and their extra length provides a large amount of leverage.

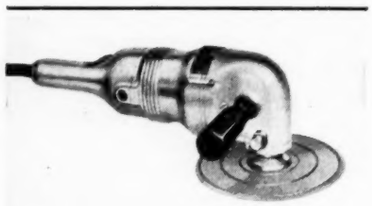
Wrenches of this type will completely rotate a hexagonal

Tap Ground from Solid Carboloy Cemented Carbide

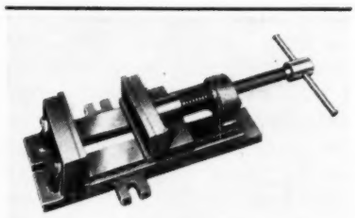
Williams Double-offset Twelve-point Box "Superrench"

To obtain additional information on equipment described on this page, see lower part of page 396.

nut when the swing of the wrench is limited to 30 degrees —less than one-tenth of a full turn. These wrenches are forged from chromium-molybdenum steel, heat-treated and chromium-plated. 91



Electric-driven Sander for Automobile Body and Fender Work



Drilling and Milling Machine Vise with Hardened Protective Plates

Milwaukee "Feather-Edging" Sander

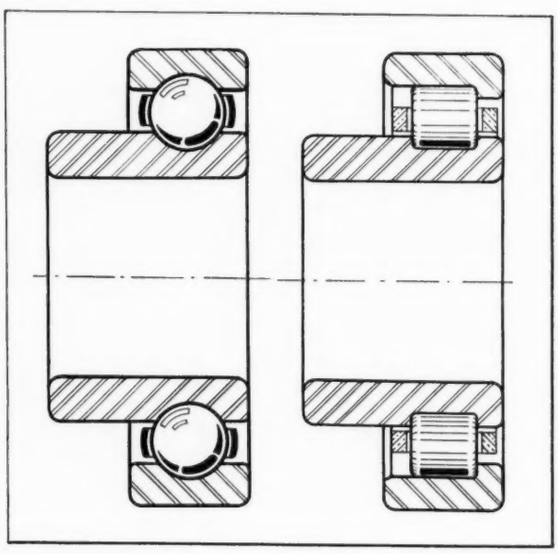
A portable electric "feather-edging" sander intended to eliminate all hand sanding and grinding in preparing automobile bodies and fenders for painting has been brought out by the Milwaukee Electric Tool Corporation, 106 N. Water St., Milwaukee, Wis. This sander can be supplied with a "feather-edging" curved flexible steel pad, nested spring-steel pads, and disks of fiber-backed abrasives and sandpaper. It eliminates all filing and scraping on reverse curves of automobile fenders and bodies. 92

Norma-Hoffmann Ball and Roller Bearings

Two new types of precision bearings—a WIR series of ball bearings and a WIR-L series of roller bearings—have recently been brought out by the Norma-Hoffmann Bearings Corporation, Stamford, Conn. The distinctive feature of these new bearings is the use of a wide inner ring of double-row bearing width in combination with an outer ring of single-row width.

These bearings have been designed primarily for opposed mounting in electric motors and similar equipment. The wide inner ring insures a better sealing on the shaft than the standard single-row ring, and in many cases, avoids the necessity of threading the shaft and applying lock-nuts or other locking devices. This elimination of threads permits a larger shaft extension diameter for a given bearing bore and avoids weakening of the shaft by threading.

The WIR ball bearings are available in the medium metric series with bores from 25 to 55 millimeters, while the WIR-L roller bearings with a one-lipped outer ring are available in the medium metric series with bores from 30 to 130 millimeters. 93



Norma-Hoffmann Bearings with Inner Ring of Double-row Width and Single-row Outer Ring

Simplex Drilling and Milling Machine Vises

The No. 6 Simplex drilling and milling machine vise brought out by the Desmond-Stephan Mfg. Co., Urbana, Ohio, is provided with hardened steel plates that cover the work-base and prevent the drilling of holes in the vise. This insures that the full strength and gripping power of the vise will be maintained. The vise screw is fitted through a bronze bushing which can readily be replaced when necessary.

Hardened and ground jaws, 6 inches wide by 2 1/2 inches high, are supplied. Offset jaws, as illustrated, or straight-face jaws can be furnished. The maximum jaw opening is 6 1/2 inches. The vise weighs 50 pounds. 94

* * *

What Congress Can Do to Restore Confidence

The Machinery and Allied Products Institute, 221 N. LaSalle St., Chicago, Ill., has published a booklet entitled "What Congress Can Do to Build Confidence, Increase Employment, and Restore Recovery." This pamphlet consists of a reprint of a statement by William J. Kelly, president of the Machinery and Allied Products Institute, before the Senate Committee on Unemployment and Relief. The booklet points out the essentials to a restoration of confidence. It discloses the false premises on which some of our tax measures are based, especially the Undistributed Profits Tax.

To obtain additional information on equipment described on this page, see lower part of page 396.

NEWS OF THE INDUSTRY

Canada

CUTLER-HAMMER, INC., Milwaukee, Wis., announces that a company known as CANADIAN CUTLER-HAMMER LIMITED has been organized for the purpose of manufacturing Cutler-Hammer motor and generator control products for the Canadian market. The Company will be a subsidiary of the AMALGAMATED ELECTRIC CORPORATION LIMITED, which will provide the manufacturing facilities. The new Company's headquarters will be at 384 Pape Ave., Toronto 6, Canada. The NORTHERN ELECTRIC COMPANY OF CANADA, for many years the principal distributor for Cutler-Hammer in Canada, will act as the distributor for the new Canadian company.

HIGH SPEED HAMMER CO., INC., Rochester, N. Y., has appointed the CANADIAN FAIRBANKS-MORSE CO., LTD., exclusive representative in the province of Quebec, in addition to Ontario, for both High Speed riveting hammers and High Speed precision drilling machines.

Illinois and Indiana

ROBERT W. HUNT CO., Chicago, Ill., an organization devoted to consulting engineering service and research and the inspection and testing of engineering materials and structures, is celebrating its fiftieth anniversary this year. The company was founded in 1888 by Captain Robert W. Hunt, a pioneer in the manufacture of iron and steel and, in his day, one of America's most prominent metallurgists.

ROBERT M. ONAN has been appointed salesman for the refractories section of the Abrasive Division of the Norton Co., Worcester, Mass. He will make his headquarters in the Chicago office, and will cover Illinois, Wisconsin, upper Michigan, Indiana, and Missouri. Mr. Onan has had nearly twenty years' experience in refractories work, most of it in the Chicago district.

E. V. WENZELL has joined the selling organization of the Marshall & Huschart Machinery Co., 571 Washington Blvd. at Jefferson, Chicago, Ill.

ECLIPSE COUNTERBORE CO., 7410 St. Aubin Ave., Detroit, Mich., has appointed the GEORGE O. DESAUTELS CO., 334 Postal Station Bldg., Indianapolis, Ind., representative for Eclipse products in the state of Indiana (with the exception of the northwest corner of the state) and in that portion of Kentucky bordering Indiana.

Michigan

MEL KORDENBROCK, formerly with the Lodge & Shipley Machine Tool Co. and the Sterling-French Machinery Co., announces the opening of the KORDENBROCK MACHINERY CO. at 2842 E. Grand Blvd., Detroit, Mich. The new company will represent the Reed-Prentice Corporation, the Partool Machine Co., the Detroit Universal Duplicator Co., and A. P. de Sanno & Son.

HENRY C. LIMBACH, formerly with the Fredericksen Co., Saginaw, Mich., has become associated with the Riverside Foundry & Galvanizing Co., 508 Harrison St., Kalamazoo, Mich., in the capacity of directing sales and engineering for the non-ferrous division.

WATSON-STILLMAN CO., Roselle, N. J., manufacturer of hydraulic machinery, has transferred its district sales office from Columbus to Detroit. J. C. GRINDLAY, western sales manager, will be in charge of the new office which is located in the Book Bldg.

New England

CONSTANT BOUILLON, chief engineer of the Hendey Machine Co., Torrington, Conn., recently completed fifty years of employment with the company, on which occasion he was the recipient of congratulations and testimonials from the company and from his associates and friends.

J. E. MACMAHON, formerly assistant sales manager of the Graton & Knight Co., Worcester, Mass., has been appointed general sales manager to succeed C. O. DRAYTON, who recently resigned. Mr. MacMahon has had many years of experience with the company, including work in the factory and engineering department, as well as selling experience. In recent years, he has been employed in an executive capacity in the sales promotion and advertising departments, as well as the sales department.

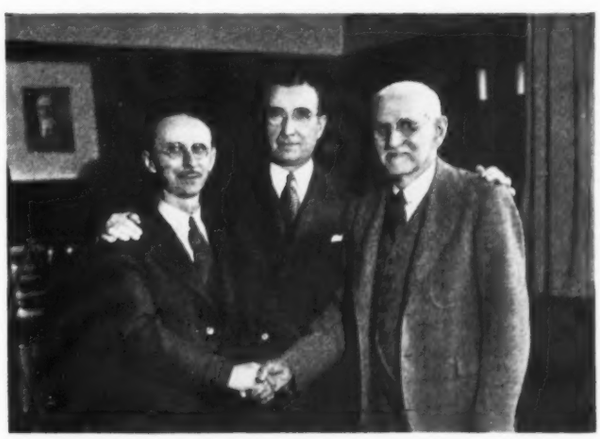
New Jersey

DIEHL MFG. CO., Elizabethport, N. J. (Electrical Division of Singer Mfg. Co.), a pioneer manufacturer of electric motors, generators, and fans for commercial, industrial, marine, and residential use, celebrated its fiftieth anniversary by a golden anniversary dinner at Elizabeth, N. J., January 7, at which were present 170 members of the sales and manufacturing organizations.

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., has recently acquired an interest in the MOORE STEAM TURBINE CORPORATION, of Wellsville, N. Y.

New York

CARL ZEISS, INC., 485 Fifth Ave., New York City, manufacturer of precision gaging tools, measuring instruments, toolmakers' microscopes, and projectors, recently appointed the following district representatives: SID LANGSTON, 1213 W. Third St., Cleveland, Ohio, for northern Ohio; EDWARD W. VOSS, 2882 E. Liberty St., Pittsburgh, Pa., for Pittsburgh, west-



Mr. Bouillon, Chief Engineer of the Hendey Machine Co. (Left) being Congratulated on his Fifty-year Service Record by W. P. Norton (Right), Inventor of the Quick-change Gear-box, First Applied to Hendey-Norton Lathes in 1892. Mr. Ayr, President and General Manager of the Company, Stands in the Center

ern Pennsylvania, and West Virginia; HIGGINS & LINDE, INC., 564 W. Randolph St., Chicago, Ill., for Chicago, southern Wisconsin, and northern Indiana.

A. T. CHANDONNET, formerly secretary of the manufacturing committee of the General Electric Co., Schenectady, N. Y., is now assistant manager of the Elmira Foundry Co., Inc., Elmira, N. Y., an affiliated company. GILES S. MAXWELL, present supervisor of costs, will succeed Mr. Chandonnet as secretary of the manufacturing committee. THOMAS D. FOY, connected with special assignments in the manufacturing organization, will succeed Mr. Maxwell as supervisor of costs.

W. C. LIPE, INC., Syracuse, N. Y., has purchased the lathe division of the Porter-Cable Machine Co., also of Syracuse. The new owner will continue the production of the entire Porter-Cable line, consisting of the 9-inch production lathe, the Mechanical Carbo lathe and the Hydraulic Carbo lathe. The Porter-Cable Machine Co. will now concentrate all its production facilities on its line of portable tools for woodworking.

GANO DUNN, president of the J. G. White Engineering Corporation, New York, on January 26 was awarded the 1937 Thomas A. Edison medal of the American Institute of Electrical Engineers "for distinguished contributions in extending the science and art of electrical engineering, in the development of great engineering works, and for inspiring leadership in the profession."

INTERNATIONAL ACETYLENE ASSOCIATION, with headquarters at 30 E. 42nd St., New York City, recently elected the following officers for the year 1938 at the annual meeting of the Association in Birmingham, Ala.: ELMER H. SMITH, president; H. P. DOLISIE, vice-president; H. F. REINHARD, secretary; and HENRY BOOTH, treasurer.

GEORGE CAMPBELL, manager of the Schenectady local sales office of the General Electric Co., Schenectady, N. Y., has assumed the added responsibilities of the management of the Syracuse office. Mr. Campbell succeeds A. J. HORNSBY in the Syracuse area, who retired on December 31 after thirty-eight years of service with the company.

TRIPLEX MACHINE TOOL CORPORATION, 125 Barclay St., New York City, on January 10 opened a machine tool demonstration and show at its showroom. This demonstration will continue until February 20. About ten different types of machine tools handled by the corporation will be shown in operation.

D. M. CURRY, of the Development and Research Division of the International Nickel Co., Inc., 67 Wall St., New York City, recently gave an illustrated lecture before the Philadelphia Chapter of the American Foundrymen's Association on new developments in white nickel casting alloys.

SPENCER LENS CO., 19 Doat St., Buffalo, N. Y., recently purchased twenty-five acres in Cheektowaga, on which it plans to build a new plant to take care of its expanding business. The present plant on Doat St. will be continued.

JOHN F. CUNNINGHAM, supervisor of production for the General Electric Co., Schenectady, N. Y., since September, 1931, has been appointed assistant to the vice-president in charge of manufacturing, succeeding MYRON F. SIMMONS, who is retiring.

KARL A. PAULY, engineer of the industrial department of the General Electric Co., Schenectady, N. Y., has resigned after thirty-nine years of service. He will continue to act in a consulting capacity.

NATHAN R. BIRGE, assistant to the president of the General Electric Co. Schenectady, N. Y., since 1927, has been elected a vice-president.

Ohio

ALLEN-BRADLEY CO., manufacturer of motor control equipment, announces the removal of its Cincinnati office from 602 Cincinnati Terminal Warehouse to new and larger offices at 2331 Reading Road, Cincinnati. W. L. Jaeckel is district manager.

VERNON E. WALTERS has recently joined the staff of the Kent-Owens Machine Co., Toledo, Ohio, as factory manager. Mr. Walters was previously master mechanic with the Inland Manufacturing Division of General Motors at Dayton, Ohio. He has been allied with the automotive industry for the last eighteen years, serving both the General Motors and the Chrysler corporations. Prior to that he was engaged in the manufacture of firearms with the Savage Arms Co. and the Ross Rifle Co.

Vernon E. Walters, New Factory Manager of the Kent-Owens Machine Co.

GEOFFREY R. BENNETT has been made general manager of the Toledo Scale Co., Toledo, Ohio. Since 1931, Mr. Bennett has had general supervision of the shop and engineering work of the company. His new position will extend his responsibilities to cover the other departments of the business. GRANT M. RICHARDS has been made plant superintendent. Mr. Richards has been with the organization since 1914.

HAMILTON TOOL CO., Hamilton, Ohio, manufacturer of mill-cut rotary files, portable elevating tables, special machinery, and fine tools, has purchased the line of sensitive drilling and tapping machines of the late ADOLPH MUEHLMATT, Cincinnati, Ohio. The line will be continued under the name of Adolph Muehlmatt Division of the Hamilton Tool Co.

HALVOR O. HEM, chief engineer of the Toledo Scale Co., Toledo, Ohio, was awarded life membership in the American Society of Civil Engineers at a recent meeting of the Toledo section. Mr. Hem has been with the Toledo Scale Co. almost since it was founded. He started his career as a worker in the jewelry and watch trade in Sweden.

AJAX MFG. CO., Cleveland, Ohio, announces that the United States Sixth Circuit Court of Appeals has decided in favor of the Ajax Mfg. Co. the patent infringement suit relating to certain improvements on heavy-duty forging machines which was brought against the Ajax Mfg. Co. by the National Machinery Co., Tiffin, Ohio.

MARTINDALE ELECTRIC CO., Cleveland, Ohio, has purchased the HERGI MFG. CO., of Bridgeport, Conn., and has moved the factory to Cleveland, where it will continue to manufacture a line of motor-driven flexible-shaft equipment, and carbon, alloy, and high-speed steel rotary files, rasps, and burrs.

Pennsylvania

JESSOP STEEL CO., Washington, Pa., announces a further service for users of composite die section steels. An arrangement has been made with the FORGINGS AND CASTINGS CORPORATION, of Ferndale, Mich, whereby the sales force of the Jessop Steel Co. is enabled to offer complete service on die construction steels. Curved sections of Jessop rolled composite die section steel (water-hardening inserted tool steel), as well as the same grade in bar and cut form, can now be obtained. Straight sections